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Lessons Learned in Converting Residential Courseware to Transportable Courseware

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13. ABSTRACT *(Maximum 200 words)*

This report documents one phase of the Guidelines for Transportable Education and Training (GTET) project, a Joint Services effort. The report presents recommendations to guide training managers and instructional development teams through an instructional design and development process for creating transportable education and training materials. Lessons learned address such topics as team assignments, lesson specifications, authoring aids for computer-based instruction, and evaluation of student performance. The appendices include sections on the Instructional Systems Development (ISD) process, the Systems Engineering for Instructional Development (SEID) process, as well as examples of forms and procedures used in the instructional development phase of the GTET project.

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FOREWORD

This report was prepared by the Navy Personnel Research and Development Center (NAVPERSRANDCEN) to document its involvement as principal developer of Guidelines for Transportable Education and Training (GTET). The Joint Services Manpower and Training Systems Development Program funded the project through Program Element 0604722A.

The report documents some lessons learned during the prototype lesson design and development phase of the GTET project. It describes potential problem areas and recommends solutions to them.

The authors wish to recognize and thank CAPT Terry Adler of the Air Force Institute of Technology, MAJ Nancy Crowley of the Air Force Systems Command, Ms. Marian Banfield of the Army Materiel Command, and Ms. Nancy Doody of the Consolidated Civilian Personnel Office for their help in facilitating the evaluation of the training materials; and Mr. Jim Sheldon and the many subject matter experts at the Defense Systems Management College whose contributions were invaluable to the lesson design and development.

Questions regarding this work can be directed to Dr. Michael Flaningam, Principal Investigator, Code 162, Navy Personnel Research and Development Center, San Diego, California 92152-6800, (619) 553-0554 or AUTOVON 553-0554.

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SUMMARY

Problem

Transportable education and training courseware is becoming increasingly important to the military as an alternative to residential classroom instruction, which is expensive, usually unstandardized, group-oriented, and limited to small numbers of students.

Objective

Military training managers need guidance to translate residential classroom instruction into transportable instruction. Not only do they need detailed guidelines to help them plan and carry out the many steps in developing transportable courseware, they also need advice from teams of developers who have completed the process.

Approach

A team of training developers at the Navy Personnel Research and Development Center put together a number of recommendations ("lessons learned") based on their experience in converting residential courseware to transportable courseware. The recommendations address many of the typical problems associated with the instructional development process and suggest practical solutions to them.

Results

Over 70 recommendations are presented that cover all phases of the courseware design and development process. The topics range from team assignments to lesson specifications, from authoring aids for computer-based instruction to evaluation of student performance.

Conclusions

Developing transportable courseware is a complex process. However, if sufficient time is devoted to planning and preparation, many of the difficulties typically encountered in developing courseware can be averted or minimized.

CONTENTS

LIST OF FIGURES

I. INTRODUCTION

A. THE GTET PROJECT

This report documents some lessons learned during the prototype lesson design and development phase of the GTET project. GTET, or Guidelines for Transportable Education and Training, is funded by the Joint Services Manpower and Training Systems Development Program. One major objective of GTET is to develop guidelines for training managers who are converting residential courses into more cost-effective transportable ones.

The services have large and diverse populations of personnel who work at many locations and require training in a variety of subject areas. Non-residential instruction can provide more standardized instruction than conventional instruction if the content is systematically designed and presented. Transportable materials can reach more people more cost-effectively than residential instruction because they can be duplicated for any number of additional students. These conveniently packaged lessons can also be used as refresher courses. Transportable lessons are also time-efficient because they can be structured to adapt to individual skill/knowledge levels. Moreover, they can be attended to when it is most convenient for the student.

Currently, most acquisition management courses are conducted in conventional classrooms that are limited in size and in their availability. Flexibility of the instructors to adapt to individual students is likewise limited. Also, classroom instruction varies greatly from teacher to teacher and even from semester to semester for the same teacher. These classroom courses also require students to travel to and live in locations distant from their work sites, sometimes for as long as 20 weeks. The per diem costs and associated labor costs due to time away from work are considerable.

One product of the GTET effort is the document *Guidelines for Transportable Education and Training (GTET)* (in preparation), which is intended to lead managers through the complex process of converting residential courseware into transportable courseware. These *Guidelines* are especially useful for developing nontechnical courses, such as those concerned with acquisition management. Acquisition management education was, in fact, selected as the content area to be explored during prototype development of transportable lessons. This area was chosen because of the need, as noted by Congress, the Office of the Secretary of Defense, and the military services, to improve the way the military acquires weapons and other supplies.

Participants in developing and evaluating the guidelines and training materials include the Navy Personnel Research and Development Center (NAVPERSRANDCEN), the Defense Systems Management College, the Army Materiel Command, the Air Force Institute of Technology, the Air Force Systems Acquisition School, Naval Air Systems Command, Naval Sea Systems Command, and the Army Training and Doctrine Command.

B. PURPOSE AND ORGANIZATION OF THE REPORT

This report describes the lessons learned by a team of NAVPERSRANDCEN instructional developers while planning and producing transportable instructional materials for adult learners. During the effort, varied procedures were used, with some discarded in favor of others. This report is an attempt to help other developers of transportable (also called exportable, distant, distributed, portable, correspondence) educational products work through the often complex process of creating quality instructional materials.

The report's organization generally follows that of the Systems Engineering for Instructional Development (SEID) process (i.e., analysis, design, development, implementation, and evaluation), which is a variation of the Instructional Systems Development (ISD) process. Since the SEID and other versions of the ISD are well documented elsewhere (see Appendix A for an overview of the SEID approach and Appendix B for a list of selected references on ISD-related publications), we make no attempt here to present a comprehensive overview of the underlying process used. Also, we do not separately address the implementation phase, which is a part of both the SEID and ISD processes. Since we were not the implementers in this instance and since lessons learned about implementation were relatively few, we included what we had in the evaluation phase section.

The flow charts that appear in the report are included only to illustrate the topics covered in the report. They do not represent models of the entire instructional development process.

Some of our recommendations mirror those found in ISD sources. We repeat them here to underline their importance. Some of our other lessons learned deal with small practical details that might be overlooked in more theoretical writings.

We begin with a discussion of personnel issues, in particular the setting up of the team that will create and develop the transportable instruction. There are some issues, such as planning and communication, that apply to the whole process and not just to one category. Lessons learned about these issues are discussed in the first section on team functioning and elsewhere where they are relevant. The discussion then moves to the general topics of analysis, design, development, and evaluation. We grouped the recommendations within these broad categories.

Although there are many ways to present courseware (such as print documents, computer-based instruction, interactive videodisks, lectures, simulators, large screen projectors), this report focuses on the media used in our effort--the print medium and the computer-based medium. However, some of the recommendations can apply to other media.

II. TEAM FUNCTIONING

Since the SE/ISD process usually involves a team effort, one interest of the GTET project at NAVPERSRANDCEN was to investigate the composition of development teams. The development of educational materials is an iterative process, requiring various skills. There are many roles a member can fill on a team, and a single individual may fill one or more roles, depending on need and capability.

The project team for the NAVPERSRANDCEN effort consisted of three functional groups--instructional developers (both experienced and novices), subject matter experts (SMEs), and coordinators/facilitators (Figure 1). Our recommendations about project teams are based on our experience with these groups.

A. INSTRUCTIONAL DEVELOPERS

Since one person may assume one (or all) of the traditional SEID or ISD roles, hereinafter referred to collectively as "SE/ISD," the term "instructional developer," or "ID," will be used in this report to refer to all the traditional SE/ISD roles of analyst, designer, author, and evaluator. Essentially, all roles other than the SME role and coordinator/facilitator role fall under the umbrella of ID. A description of the traditional ID roles within the context of the SE/ISD process is presented in Appendix A.

At NAVPERSRANDCEN, a core group of two to four developers composed of an experienced ID and novice IDs (student contractors) participated at all levels of the development effort, from planning and scheduling to proofreading and copying of computer disks. The student contractors had some experience with microcomputers, but none developing transportable materials. They were trained to program the actual content of the lessons into two versions (a print version and a computerized version) from the lesson specifications. A second team was composed of outside IDs who developed several of the lessons, both print and computer versions. (The decision to use outside contractors to fill team roles is normally based on the availability and experience of personnel as well as on budgetary concerns.)

Lessons learned are presented below in the form of recommendations. Those directly below focus on the two major concerns of an experienced ID--assigning project tasks and training others as IDs (see Figure 2).

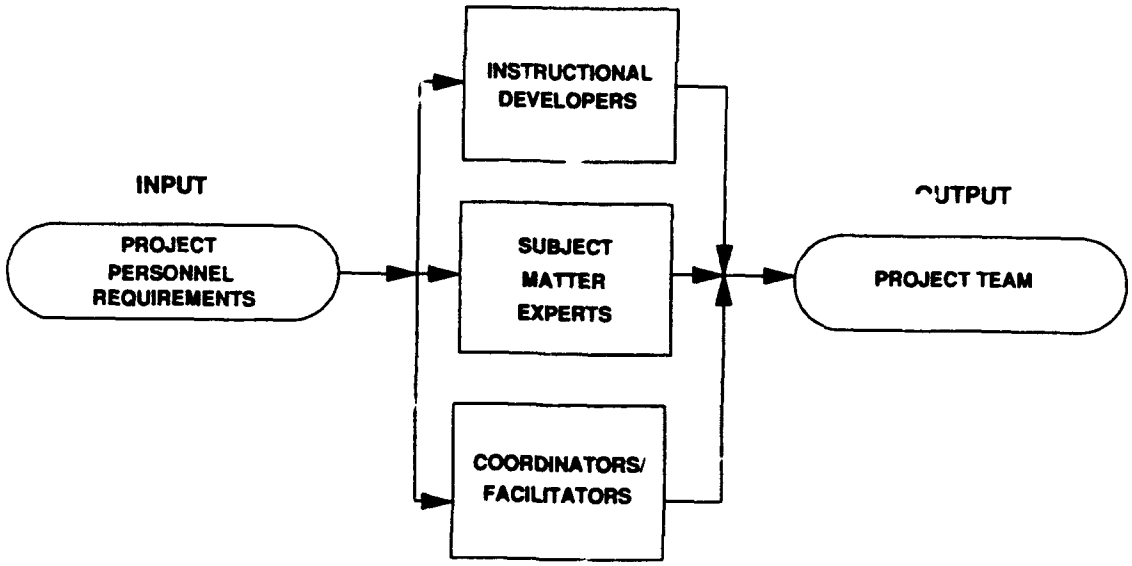

Figure 1. Formation of an instructional developmer project team.

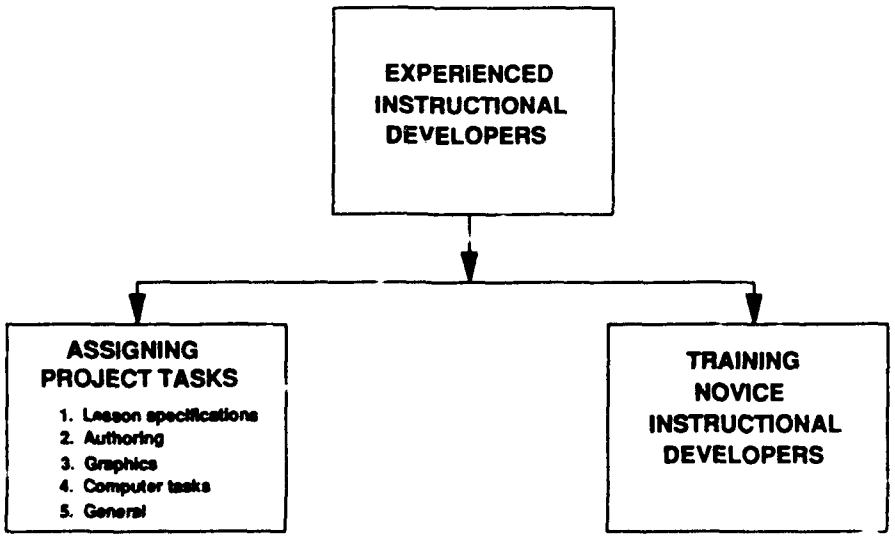

Figure 2. Tasks typically undertaken by instructional developers.

1. Assigning Project Tasks

Recommendation: IDs should define the tasks of lesson specification designers and lesson authors before they begin lesson construction.

Task assignments for the lesson specification designers and lesson authors largely depend on the number, skills, and experience of available personnel. The ID needs to decide which people will be assigned to which tasks before determining how long each task will take and when milestones can be reached.

a. Lesson Specification Assignments

If the same author develops both the lesson specifications (design phase) and the lesson content, inconsistencies between them will be easier to spot. Also, by working closely with the topics involved, the author will eventually become a quasi-expert on the material.

When economic or personnel constraints dictate that different individuals develop the lesson specifications and corresponding lesson content, then the lesson content author must take the time to become thoroughly familiar with the specifications. In our effort, outside contractors prepared the lesson specifications, with some of the lessons then developed by in-house personnel and some by the contractors. It took some time for the in-house team members to become familiar with the specifications, and it increased the need for the SMEs (professors at the Defense Systems Management College) to provide feedback on the lesson materials to ensure that the lessons accurately depicted the specifications.

b. Authoring Assignments Using One Medium

If only a print medium is used, the same author can usually complete all the text content of a single lesson if the lesson is not excessively long. However, if the one medium is computer-based or uses interactive videodisk, it might require the knowledge of several software packages (for example, a word processor to create the text, an authoring system to translate it into a lesson, a graphics package for pictures). In this case, either one person must be able to work with several software packages and methods or several people must work on different aspects of each lesson.

c. Authoring Assignments Using More Than One Medium

If more than one version is being developed (such as a print version and a computer-based version), several approaches are possible, and each has certain advantages.

Same-Author Method. For some of our lessons, the same author completed the text of both the print and computer versions. These authors developed good relationships with the relevant SMEs and became knowledgeable about the content and how best to present it. This method also works well because an author is more likely to spot inconsistencies between the

print and computer versions during development. The optimum approach would be to have personnel able to work with several media who can individually work through both versions.

Different-Author Method. For other lessons, different authors completed the texts for the print and computer versions. This option proved most efficient when time was limited and some IDs were new to the software packages. If training a team member on how to use the software is going to take too long, it might be more efficient to let the trained team members develop the computerized versions, while that team member develops the print versions.

d. Graphics Assignments

Recommendation: At least one team member should be skilled at creating graphics.

In determining this assignment, consider the artistic ability of lesson developers. Be aware that some people do not have sufficient interest or ability to make good detailed drawings, even with a computer program as an aid. Therefore, in choosing team members, look for someone with graphics skills. One option is to have an experienced graphics person create all or most of the graphics for the lessons. We used this option several times.

If no team member is especially skilled, or if several team members have graphics skills, it might be more practical to have each person create his/her own graphics. When using this option, detailed guidelines on style and format should be set up to ensure consistency across lessons.

e. Computer Assignments

Recommendation: At least one team member should be adept at computer use, specifically in terms of operating systems and hardware.

Computer glitches can and will occur. Hardware problems, such as faulty disk drives, and software tasks, such as installing and learning new graphics packages, can be more readily accomplished by a team member familiar with the more technical aspects of computers. In some organizations, a support staff provides these services. Because these personnel may not be available at critical times, we recommend that one member of the team be able to create and run batch files, install graphics boards, use a computer operating system, troubleshoot minor hardware problems, set up an interface between a computer and a printer, etc.

f. General Assignments

Recommendation: Backup personnel should be available for assignments.

It is worthwhile to identify people on the team who could serve as backups and/or to train new members in a variety of skills. For example, if only one team member is knowledgeable

about the authoring system or the graphics package, unavailability of this member for any reason could delay the project. We therefore recommend cross-training so that at least two people are knowledgeable about the various tasks, including technical skills required for using various software packages.

2. Training Novice IDs

Recommendation: The team leader needs to determine what and how much a novice needs to know to perform adequately in each technical area and how long it will take to train a novice to perform the various tasks.

Unless an organization has a team of IDs experienced in all aspects of lesson construction (including the media), some training will be necessary. Training should cover the (a) ISD process; (b) basics of computer-based instruction and screen design; (c) word processing system; (d) lesson authoring system, and (e) graphics programs.

The learning time for each will vary according to the complexity of the programs as well as the experience and motivation of each learner. Even with software programs that help a new user learn its tools quickly, it will take time before quality products can be created. The time required to train novices will affect the product delivery schedule as well as the quality of the final product.

Recommendation: All IDs, whether they are experienced, novice, or contractor personnel, must be provided with copies of applicable standards and references before beginning lesson construction.

These materials should be supplied to all team members, even if they are experienced in lesson construction, and to contractors. Periodic reviews of their work should be scheduled.

Recommendation: When employing contractors, an organization should specify in the contract that contractor personnel must have certain capabilities and experience to work on the effort.

If contractors must have certain skills to be effective team participants, these skill requirements should be included in the training plans.

B. SUBJECT MATTER EXPERTS

The subject matter expert (SME) serves as the consultant to the IDs regarding the adequacy and validity of the lesson content and test items. The SME provides the expertise needed to ensure that the content of the instruction and test items is correct and presented clearly, effectively, and with suitable detail to accomplish the instructional goals. In our effort, SMEs (who were located at a resident instruction school at a remote site) provided the basic

instructional materials that they used in teaching classroom versions of the lessons. They also reviewed and provided feedback on the developing lesson materials.

Over time, the SME will become a novice ID, and the ID will become a novice SME. When this happens, communication becomes more effective and efficient. How quickly this occurs depends on many things, from the experience, motivation, and background of the individuals to the difficulty or complexity of the subject matter. An SME needs to accept the fact that an ID will have some ideas that may seem foreign, but yet may work very well. Likewise, an ID needs to be prepared for the fact that the SME's knowledge and terminology may be difficult to grasp.

The SMEs play a crucial role in the whole process of developing instructional materials. The more open the communication between the SMEs and the IDs, the better the products. We recommend the following actions to ensure that communication remains open throughout the process.

Recommendation: The team leader should establish from the outset who the SMEs will be for each lesson.

Each lesson should have at least one SME who is the main source of information for establishing and reviewing the content of the lesson.

SMEs also need to understand from the start their role on the development team. SME involvement during the earliest phases should help ensure the adequacy of the lesson specifications and thus ease the process of developing the instructional materials.

Recommendation: Before beginning lesson development, the team leader should determine how available each SME will be to the IDs.

Each SME's calendar needs to be coordinated with the lesson development calendar. If sufficient time is unavailable, the team leader should either negotiate for more time or consider finding a different SME. And, since SMEs are usually working full time at other jobs, it is important to set up a communication system that is nonintrusive and easy to use so that SMEs and IDs can exchange information quickly during lesson production. Ideally, SMEs work at the same location as the lesson developers.

Recommendation: If at all possible, the same SMEs should be used throughout course development.

For the sake of continuity, the team leader should try to employ SMEs who are able to support the project for its duration. A change of SME midway through design or development could change the direction of a lesson, possibly lengthening the entire development process and forcing the ID team to miss due dates. For one of the lessons developed at NAVPERSRANDCEN, SMEs changed twice, once during the lesson development and again

during the review process. One new SME saw the purpose and direction of the lesson as significantly different from that of the original SME. These SMEs had different instructional philosophies and differed in their view of what the lessons should accomplish. Unfortunately, the change happened after early drafts of the lesson had already been completed. This change complicated the lesson development and extended the time needed to complete the lesson.

Recommendation: The team leader should outline what each SME is expected to contribute to the effort.

The SMEs need to understand from the beginning what types of materials and expertise they are being asked to provide. This helps define the role of the SME and eliminates confusion about what is expected.

Recommendation: The team leader should designate one SME who has the authority to give final approval to a lesson.

This designation is especially important if more than one SME is involved in the development of a lesson or if lessons draw on SMEs from several disciplines.

Procedures should be established as early as possible by the team leader to help SMEs reconcile differences over lesson content or specifications.

To illustrate: One set of our lessons covered varying topics and relied on SMEs from different educational departments. There was no coordinator selected to oversee these various contributions. This module did not have the consistency of thought that other lessons did that either originated in a single department or were shaped by a single SME.

Recommendation: The SMEs should be encouraged to become integrally involved in the development of the instructional materials by helping them see themselves as the lesson content developers.

Describe the role of the ID to the SME as the presenter and organizer of the lessons, that is, the ID actuates the SME's methods and knowledge according to instructional development principles. Each party should view the process as a joint effort. For example, the term "*our* materials" should be used instead of "*your* materials" or "*my* materials." The fact that the *whole* team owns the lessons should be emphasized.

C. COORDINATORS/FACILITATORS

Coordinator/facilitator activities focus on locating and coordinating students/evaluators who can use the instructional materials systematically and provide feedback on their quality. For both the formative and summative evaluations, coordinators from all of the military services participated by arranging for students/evaluators and instructors to go through the lessons and fill out feedback forms assessing the materials.

Many of the recommendations regarding communication between IDs and SMEs apply here as well. In fact, SMEs may also serve the role of coordinator/facilitator. The reader is also directed to the evaluation phase section of this report, which continues the discussion of coordinators/facilitators.

III. ANALYSIS PHASE

Thorough front-end analysis is one of the most important activities in the process. It describes the current course or program systematically and sets the foundation for the lesson specifications. Complete and accurate lesson specifications, in turn, help to ensure valid lesson content.

The SE/ISD approach emphasizes that the analysis and design phases must be completed before courseware is developed (see Figure 3). Within the analysis phase, the current course is reviewed and a determination is made of what changes are needed (see Figure 4).

Because contractors conducted the analysis for our project, we do not have many first-hand lessons learned; however, we do have some general recommendations to make.

Recommendation: Sufficient time should be scheduled for the front-end analysis.

This is vital, since a thorough analysis is a time-consuming part of the SE/ISD process.

We cannot advise the reader about the exact amount of time required because it depends on factors such as the state of the existing documentation, the complexity of the tasks and concepts to be taught, and the availability of SMEs.

Recommendation: Analysts need to learn about the lesson users.

Analysts should carefully describe the learner population so that the level of depth and detail of course content can be set appropriately. The most useful information describes the learner's range of experience and education.

Recommendation: The analyst (who could be the team leader or one of the IDs) should obtain all documents and content resources (e.g., reference manuals, standards and specifications, user manuals) that will be needed by team members.

The more resource materials, references, and other documentation available to the IDs, the better. The SME is often the best source of lesson content information. All team members should be working from the same set of materials (same dates, same versions), and all materials should be the most current and most accurate available.

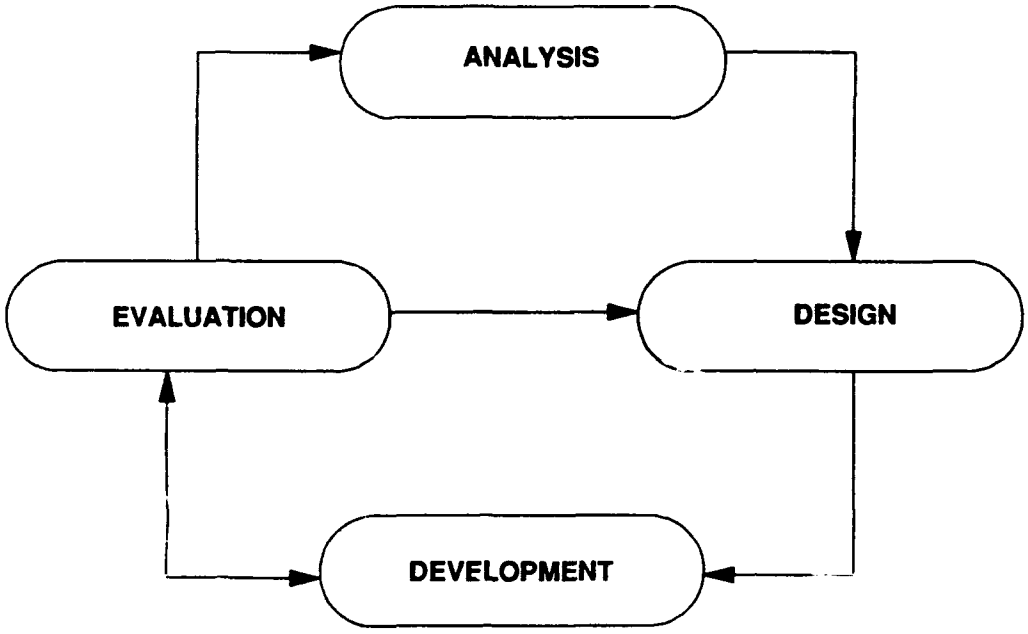

Figure 3. Flow chart illustrating the relationship of the four phases of the SE/ISD process.

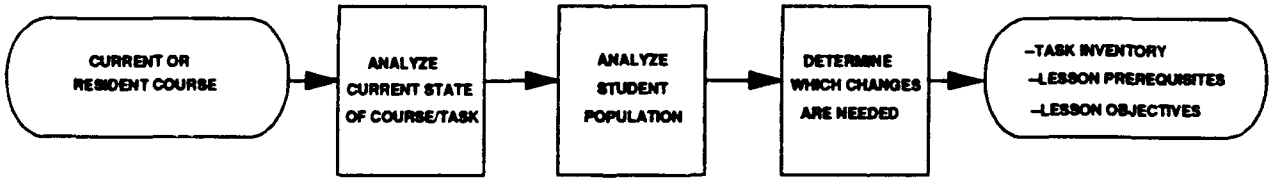

Figure 4. General steps to follow in the analysis phase.

IV. DESIGN PHASE

In general, designers use the results of the analysis phase to determine the media, instructional strategies, testing strategies, and management strategies most appropriate to the tasks to be learned. Our lessons learned for the design phase cover the creation of lesson specifications and design tools to aid in the overall design and development process. First, however, we make one general process management recommendation.

Recommendation: Designers should plan for the unexpected.

When planning and scheduling the entire effort, time lines should be generous to allow for the unexpected, such as (a) permanent departure of employees; (b) hardware failures; (c) funding cuts; (d) unanticipated problems with SMEs; (e) unanticipated problems with any team member or with lessons materials, etc.

A. CREATING LESSON SPECIFICATIONS

The outcome of the design phase is the development of lesson specifications. Generally, lesson specifications contain an outline of the lesson structure, the lesson objectives, test and practice items, examples, the essential content information of the lesson, and instructional strategies. Appendix C contains sample lesson specifications used in our effort, and Appendix B contains ISD references that outline further what lesson specifications should contain.

First we will discuss some overall recommendations that deal with lesson specification issues. Then we will present lessons learned about decisions that must be made when creating lesson specifications--selecting which media to use, selecting hardware, selecting software, structuring the materials, and setting up the testing strategies (Figure 5).

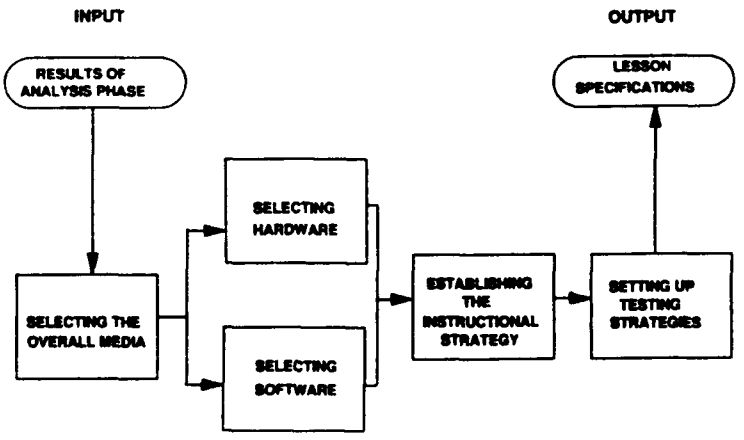

Figure 5. Decisions to be made in developing lesson specifications.

1. Getting Started

Recommendation: The team leader should communicate to team members and SMEs the purpose, use, form, and extent of lesson specifications.

If any team members are unfamiliar with how specifications are developed and what they are used for, they might not adequately review the specification outline, which, in turn, will affect their products.

Since SMEs contribute significantly to the process, they must also be informed about specifications. When the SMEs help design and complete the specifications, the team leader should explain that the specifications must be extensive, detailed, and valid, and that the content may be expanded upon or deleted as need be as lessons progress through the development phase. Sketchy specifications or ones that leave issues open to interpretation will cause future difficulties that will have to be resolved. Lesson structure should be clearly delineated, testing strategies should be thoroughly covered, test and practice items should be developed based on the lesson objectives, and examples should be clearly and fully described.

The team leader should stress to all team members that accuracy and completeness of lesson specifications are crucial to developing lessons that are accurate and complete. Until the team agrees that the specifications are complete and valid, development cannot (or should not) continue.

Appendix C contains part of a lesson specification we used. Note its limitations: Although it includes *samples* of examples and test items, ideally it should have provided specific, detailed examples as well as the necessary test items.

Recommendation: The team should design the lesson specifications just prior to the lesson development.

No more than a few months should elapse between the development of the specifications and the development of the lessons. This is especially important for lesson content that might change over time.

Specifications become outdated for many reasons. Curriculum advisors change their minds about what to teach or how to teach when it comes to putting across a particular concept, and changes also take place in the world that may change the content of some lessons. If lesson specifications appear to be out of date, the team leader should consult with an SME about obtaining updated information.

2. Selecting the Overall Media

One of the decisions to be made when creating lesson specifications concerns which media to use to create and to present the lessons. During this process, there are practical, real-world compromises that usually occur. Often, decisions are not based on pedagogical grounds alone. Interests of potential users may come into play. Our recommendations focus on the print and computer-based media used in the NAVPERSRANDCEN effort.

Recommendation: IDs must recognize that not all course subjects are amenable to all media, such as the computer-based medium.

The NAVPERSRANDCEN team was directed to create both print and computerized versions of all lessons. Cost is an important consideration in making these decisions. The benefits of having two versions of the same lesson must be weighed against the cost of their creation.

There are no formulas that course designers can apply when selecting one medium over another, although some have suggested that this might be possible. There has even been speculation that some types of media (such as interactive videodisk) might be able to stimulate certain kinds of learning better than more static media. However, recent analysis (Clark, 1985; Clark & Sugrue, in press) has shown that most of the differences in student performance among the various media are likely to be due to uncontrolled variables such as instructional strategies and the motivational effects that result from the novelty of using new media. Therefore the primary factors to be considered when selecting media remain (a) the kinds of tasks and concepts to be taught, (b) the instructional strategies necessary to teach them, and (c) the costs of producing and using the resulting courseware.

Another constraint is time (see the following recommendation). Creating computer lessons that are mere "page-turners" (i.e., the lessons are not made interactive or adaptive to the learner's progress) is expensive and wastes both computer and personnel time. Conversely, certain types of lessons, such as those requiring that learners branch to different outcomes depending on a previous answer, are well suited for automation. Choosing a medium is a difficult decision, but it must be made, and made early in the design process.

For a further discussion on how to select media, the reader is directed to the list of ISD-related references in Appendix B.

Recommendation: When developing computer-based instruction, ID teams need to allow adequate time for preparation of sophisticated screen designs and "interactivity," the process by which the student and the software interact.

Computer-based courseware generally does not progress sequentially (i.e., page by page as print documents generally do). Exercising the potential of the computer-based method usually

involves more time than does the creation of print lessons. The extra time is spent incorporating more complex presentation strategies such as:

a. Multiple graphics (which are sometimes in overlays) or animations that enhance learning and retention.

b. Menus that branch to various areas within the program.

c. Interactive practice sessions.

d. Learner control of sequence and choice of material.

e. Interactive assessment and adaptive feedback.

Even if interactivity and screen design are relatively simple, it is still necessary to program the branches between screens, between screens and menus, and even to toggle screens back and forth. Since the amount and quality of learner interactivity is one estimate of the quality of a computer-based lesson, time to develop a high quality lesson must be provided.

Note, however, that developing good print versions of instructional materials is also challenging, and interactivity can be incorporated into this medium as well.

3. Selecting Hardware

If a computer is going to be used during any aspect of the courseware development, such as for word processing or as the actual medium selected for lesson presentation, hardware requirements must be determined. IDs must then ensure that the necessary hardware is obtainable. Part of this decision involves determining what off-the-shelf hardware is available or deciding if some special equipment configuration needs to be set up.

We decided to use the microcomputer (the Zenith 248, an MS-DOS-based system) because it was the system available to both the ultimate lesson managers and to the subject population in the field. This microcomputer system was used to: (a) produce the print lessons, (b) interact with the computerized authoring system, and (c) present the computerized version of the lessons.

Recommendation: Computer space requirements (i.e., disk storage space as well as memory requirements) must be addressed.

These requirements will depend on (a) the size of the lessons being developed, (b) the amount of space and memory needed to run any required software programs, and (c) the uses to which the computer will be put--for development and/or presentation.

To address the above issues, the ID team should use the results of the analysis phase in determining how large the lessons will be. Then, the team should investigate the storage and memory requirements of the software programs to be used. Space and storage requirements will be affected if several lessons are to be developed on one computer. Finally, if computer-based lessons are going to be developed, space and memory requirements of the authoring system need to be considered. Space/storage/memory considerations may be less of an issue if the computer is used only for word processing, although lesson size and the space/memory requirements of the word processing system must be considered.

Thus, if lessons are large, if several are developed on one computer, and if the lessons are to be computer-based, then an additional hard disk drive may be required as well as a high density floppy disk drive, and/or an enhanced memory board.

Recommendation: If graphics are necessary, the ID team should determine as soon as possible what kind of graphics will be required as well as what kind of graphics board and monitor to use to ensure compatibility with its own computers as well as with those of potential users.

The type of graphic equipment ranges from cga (color graphics adaptor), to ega (enhanced graphics adaptor), to vga (video graphics array), and other capabilities are being developed all the time. Because each type may require a different type of graphics board and/or monitor and since some systems won't run lessons created on a different system, the ID team should determine early if potential learners have the needed equipment to view the lessons.

Recommendation: If floppy disks are to be used, the ID team should obtain disks that are error-free.

This might seem a small and obvious point, but such details can cause serious problems and delay. For example, faulty floppy disks resulted in inoperable lessons at one point during our project. To avoid this problem, the team should test different brands of disks to determine the most reliable.

4. Selecting Software

In our project, we were instructed to use a non-proprietary, government-owned authoring system. This selection saved money since the government didn't have to buy any new software or pay fees for distribution to training sites. However, like all software, the package had limitations and several "bugs" in the system had to be dealt with during the project. When selecting any software, the ID team should try to be realistic about its limitations as well as its useful features. This approach helps prepare the team to be flexible when developing the courseware.

When planning to use computers to develop courseware, whether print documents or computer-based lessons, three or more types of software systems will be required: (a) a word processing/desktop publishing system, (b) an authoring system, and (c) a graphics package.

Recommendation: The ID team members need to ensure that the software systems are compatible with one another.

For example, an authoring system needs to be compatible with the hardware, with the graphics package (if any), and with the word processing/desktop publishing system, if the authoring system needs to interact with these other packages.

a. Interaction Between Authoring System and Word Processing System

If the authoring system must interact with a word processing system, the systems must be compatible. Our authoring system, for example, interacted with a wide variety of word processors. Other authoring systems are very specific about which word processed text they will accept. In addition, since we created both print and computer versions of lessons, and since we created the print versions first, development was streamlined because our word processing program could readily convert text to the authoring program.

b. Interaction Between Graphics Programs and Authoring/Word Processing Systems

The graphics editor used in our effort (Dr. Halo) was supported by both our word processing system (WordPerfect) and our authoring system (Computer-based instruction Authoring Tools System [CATS]). However, color graphics for computer-based lessons sometimes had to be modified for the print lessons because some color combinations did not translate well to black and white. Fortunately, the modifications were easily accomplished due to the color swapping capabilities of our graphics editor. If an effort involves using similar graphics for two media, the graphics must be able to support both media.

c. Interaction Between Software and Hardware Systems

It may seem an obvious point, but not all software is compatible with all hardware. For example, we discovered that the fonts available through the word processing system we used (WordPerfect) were not supported by all of the different printers we had available.

Although there are some ways to circumvent the incompatibility between software and hardware, modifications may be cumbersome and cause delays in meeting deadlines. If budgetary or other contract restraints require the use of a software package that entails modifying the printer interface, extra time for this correction must be scheduled.

5. Establishing the Instructional Strategy

Recommendation: The ID team should set up a general framework for the lessons.

We recommend that ID teams organize the lesson information into categories or sections (e.g., Objectives, Examples, Practice Items) that will provide structure. This is particularly important when the course materials will be used by people who have a broad range of experience, education, and interests, since students can use this organization to individualize their learning experience. For example, students who want only a refresher course or review of the topic might be instructed to concentrate on the Overview and Summary sections. Students who require more thorough training would study additional sections that present information in more detail. The less experienced learner should be provided with enough resources to adequately accomplish the lesson objectives.

Organizing information for all lessons by category or section also makes self-pacing easier because students know where they are and what kind of information they are receiving at any time. They can rapidly decide what to do next. Such organization of instructional material is *learner-centered* because it allows the learner to choose the pace and sequence of presentation.

For example, our lesson structure included the following categories:

1. **Introduction**--A statement of the lesson objectives

2. **Core Information**--The essential content of the lesson

3. **More Information**--Further details and descriptions of the core information

4. **Examples**--Hypothetical or "real life" illustrations or applications of the core information

5. **Summary**--A brief restatement of the core information

6. **Practice and Feedback**--Questions and feedback about the core information

Lesson structure can change, however, as development and evaluation continue. For example, our More Information category proved somewhat ambiguous. Questions arose as to whether this category contained only supplemental information and, thus, was not testable in the quizzes. As a result, we used the More Information category less often. We moved clarifying information into the Core Information or Examples sections.

The Table of Contents in the printed version or the menu in the computerized version of a lesson should describe categories adequately so the learner can quickly decide which categories of the instruction to study to accomplish the lesson objectives.

Recommendation: The learner is the customer.

In a customer-oriented organization, everything possible is done to accommodate the customer; within this context, the customer is the student. The format of the lessons should be user-friendly and structured so that learners always knows where they are within a lesson and what to do with any component of it. Directions should be simple. For example, at the end of each printed page, or on each computer screen, it should be clear to the learner what to do next. Developers should keep in mind that the learner's task is to learn lesson content, not to struggle with a complicated lesson format.

Recommendation: The learner needs feedback.

Feedback can be provided to users through various assessments (e.g., pre- and post-quizzes) and through exercises and examples. These mechanisms also promote interaction. However, quizzes should be introduced to users as diagnostic or prescriptive tools and not just assessments for a "score." Questions are diagnostic because they are designed to help learners determine strengths and weaknesses. They are prescriptive because they are intended to guide learners to the specific materials they need to use to accomplish the lesson objectives.

Questions, exercises, and examples should be designed so that the learner can apply cognitive skills and knowledge appropriate to the objectives. They should not be simplistic requirements that ask the student to repeat facts or bits of information based on rote memory, unless, of course, the lesson is intended as a drill to facilitate rote memorization.

Recommendation: Appendices for print lessons and users' guides for computerized lessons are useful additions to lessons.

For print versions, appendices could contain the most important content points, examples of documents, formulas, charts, and diagrams that learners could use later on the job or as a study aid for final review before the lesson test.

For computer-based lessons, printed users' guides that accompany each lesson could contain the above job/study aids as well as any other material not amenable to a computerized format. For example, some sections in our users' guides for our computer-based lessons included examples that were extensive and more easily read in a print form than on a computer screen.

Users' guides and print version appendices could also contain pages that list the learning objectives for each lesson with the suggestion that students might want to take a few notes as

they move through the lesson. The notes would serve as a summary of the lesson content and would provide a study guide for the tests. For learners using a computer-based lesson, it would also dispel any thoughts that writing on paper is somehow "primitive" and to be avoided.

Recommendation: Instructions that are standard across lessons should not be presented repetitively to students.

The user's guide we included with each of the computerized lessons contained information on how to install and use the lesson. The installation and use instructions were included with *each* lesson, though these instructions were identical for every lesson. Our purpose was to make sure the lessons could be used independently. However, in most cases, students were working through a whole series of lessons and saw some of the same instructions in each user's guide.

Based on our experience, we recommend that repetitive information such as instructions be kept in a separate booklet that can be given to each student once. Information specific to each lesson could then be distributed in a different document as needed. Students would not receive redundant material, and printing and mailing costs would be reduced.

Recommendation: For the computer-based medium, broad guidelines about the complexity of the computer menu need to be set.

Guidelines should be flexible enough to allow the lesson author some creativity, but structured enough to ensure that students know where they are within the lesson and are able to move through it without needing to learn a complicated series of movements. Menus need to serve a specific purpose, they need to be accessible at almost any point, and they should be invisible unless needed.

For example, during the formative evaluation of some of our earliest lessons, we learned that some of our nested menus were confusing to learners. (Nesting menus are a series of menus, with one leading to another and possibly then to a third before actually presenting lesson content.) These proved to be a hindrance rather than a help to learners' progress through a lesson. These menus were deleted from our computer-based lesson structure.

6. Setting Up Testing Strategies

Recommendation: Test items and practice items should be written while creating the lesson specifications.

Test items should follow directly from the lesson objectives and test only the knowledge, skills, and abilities required by these objectives. When test items and objectives are developed at

the same time, the process is simplified and far more efficient. For example, the lesson specifications developed for our lessons did not contain the complete list of test items; it proved to be difficult 2 years later to create effective items to test the objectives.

Recommendation: A variety of question types should be used when creating both practice items and quizzes/tests.

Sometimes external constraints can affect the use of a variety of question types. One such constraint is project funding--it can take more time and thus more money to develop and plan to score answers to open-ended questions. Another constraint is that the computer authoring system may be more difficult or time-consuming to program (which also translates into funding) for open-ended question types. Our lessons generally used multiple choice items, partially due to external constraints made at the project outset.

We also considered the ease of item preparation and ease of maintaining and scoring items when we designed questions. However, multiple choice items alone are not always sufficient, even though they are the most easily scored by computer or by hand. The student should be presented with several ways that test their understanding of the content, especially in practice items included within the lessons. Matching items, short-answer items, open-ended questions or questions that ask the student to solve problems similar to those presented--all of these contribute to the creation of quality instructional materials. *All* forms of questions should, of course, directly address the learning objectives stated in the lesson specifications.

B. CREATING DESIGN MANAGEMENT TOOLS

Design management tools, such as flow charts, are also created during the design phase along with lesson specifications. Design management tools can help ease the whole process of designing and developing instructional materials. We recommend creating flow charts and developing file management templates and lesson templates as tools that can help organize the instructional development process.

1. Making Flow Charts

Recommendation: Flow charts are useful in outlining and documenting the plan and progress of the development effort.

Flow charts are management tools that can be used in any of the phases of instructional development and are useful at most stages of planning and managing a project. We found them of special use in the design and development phases. Flow charts can be used to:

a. Plan the entire lesson construction effort, from analysis through evaluation.

b. Pinpoint areas in the process that are critical to timely and efficient completion of the effort.

c. Document and compare the planned process with the actual process used.

d. Document and compare the actual process used with the process recommended for future development efforts.

2. Developing File Management Templates

We developed a variety of ways to organize and track computer files. These files can be word processing files (for print lessons) or authoring system files (for computer-based lessons).

Recommendations on file management will cover the following issues: directory structure, file structure, naming conventions, file creation dates, and file/disk backups.

a. Directory Structure

Recommendation: A standard by which to structure the on-line directories should be established so that the directories reflect the hierarchy or outline of the lessons to be developed.

The computer is a powerful tool for organizing courseware. A standard, well-organized directory structure will help establish consistency and help lesson developers keep track of the development process. A sample of a directory structure that reflects the outline of lessons is presented in Appendix D.

b. File Structure

Recommendation: A standard for on-line file structure that reflects the organization of lessons should be established.

File structure will vary according to the media used and the structure of the lessons. Since we worked only on print and computer versions of lessons, the following recommendations address only those two media.

Recommendation for print versions: The word processing file for a print version of a lesson can be contained in either a single file or a number of smaller files.

This decision will depend on lesson organization, preference for working on smaller files versus one large file, whether the files will fit on one or more floppy disks, and on the characteristics of the word processing system. For example, our word processing system would not print a file if the file size exceeded half the floppy disk space. If files are split, page numbers need to be tracked to avoid gaps in numbering at final printing.

Recommendation for computer-based versions: For the computer-based lessons, we found it best to set up separate files to correspond to functional categories of the lesson, such as Core Information and Examples.

These files were shorter and easier to work with for testing with our authoring system. Since authoring systems vary in their file management capabilities, the file structures might differ to accommodate each system.

c. Naming Conventions for Directories and Files

Recommendation: The naming code should be simple and logical.

That is, the directory and file names should correspond in some way to what they contain and to where they belong in the sequence of the courseware. Examples of directory and file names for print files, computer files, and graphics files used in our project are presented in Appendix E.

Recommendation: The numbering system should provide clues to the learner.

If the ID team members are using several levels of instruction, such as major modules with smaller lessons within those modules, they should use a different numbering scheme for each to help students remember the level.

For example, Module I could contain Lessons A, B, and C, and the lessons could contain Chapters 1, 2, and 3. This scheme provides an extra clue to the learner by which to keep track of where she or he is in the lesson (i.e., letters are always lessons; chapters are always arabic numbers; modules are always roman numerals).

d. File Creation Dates

Recommendation: Dates on files should be kept current and correct.

Although this may seem trivial and obvious, keeping the correct dates and times on files is important for identifying the most current files, especially if several team members process some of the same files.

If a computer is used for word processing or computer-based authoring, the correct date and time are probably recorded automatically via a working time clock in the computer. But, if the computer does not automatically keep a time clock, there is usually a manual way to set the clock after the computer boots up. The operating system manual should describe this procedure.

If a computer is not used to process the documents, the creation date can be kept track of by simply writing the date and time on the document.

e. File/Disk Backups

Recommendation: Backup files/disks should be created regularly.

This is an elementary point but it cannot be overstressed. Mistakes and accidents can happen to computers and even to disks. We recommend that both backup disks and hard copies of documents be created to ensure survival of the product.

The frequency of creating backup material depends on how much work has been accomplished in a given period of time. If team members are working steadily over a week's time to develop a lesson, it would take at least that much time again to reproduce those efforts if disks turned out to be defective or inadvertently destroyed. Certainly backup material should be created on almost a daily basis when production of the ID team is high.

3. Setting Up Lesson Templates

Recommendation: Templates are a useful tool for lesson development.

One of the major decisions to make before writing lessons concerns formatting. This may seem at first to be working backwards--after all, if there is nothing to format, what difference does it make what typeface will be used? But consider what happens when seven lessons are written by seven authors, each with a unique style of headers, highlighting conventions, and abbreviation conventions. To make the lessons compatible, at least six of them will probably have to be meticulously revised.

To solve this problem, we recommend the use of lesson templates. By lesson templates, we mean files (either for print or computer versions) that serve as prototypes for the initial standards established for lesson development. Templates not only provide the entire lesson development process with structure, but help improve consistency within and between lessons and between different media versions of lessons. If at all possible, complete and final templates should be developed first; they should include as much detail as possible for both print and computer lessons.

The use of templates does not have to be unvarying. A different format might be used for some of the lessons to accommodate special instructional purposes or to arouse student interest with occasional visual surprises.

a. Templates for Print Versions

Templates for print versions can include details such as format instructions (margins, spacing, tabs, etc.), highlighting conventions, typefaces, wording and abbreviation conventions, headers/footers, and color restrictions, if they apply. These templates can exist in a

computerized file (in the relevant word processing format) that can be given to the lesson authors before they begin to write the lessons. Appendix F presents a sample of a format document for development of print lessons, one we used in our own effort.

b. Templates for Computer-based Versions

Templates for computer-based lessons should include standards for: (1) naming storyboards (which contain the text and other programming information for each screen), (2) positioning menus and directional cues on the screen, (3) margins, (4) centering cues, (5) color standards or restrictions, (6) branching conventions, and any other screen design conventions. Creating templates for computer-based lesson development expedites production since new information can be "read into" a set of predesigned templates and changed accordingly. Appendix G contains printouts of a template file used for the computer-based lessons in our effort.

c. Printed Reference Copies of Templates

A printed copy of both the print version templates and the computer version templates should also be available to lesson authors as reference documents. For example, our lesson authors had a binder of the printed computer-based templates to refer to when standards were in question.

d. Changes to Templates

Changes to templates should only be done for a good reason. If a template is changed, all of the materials already produced will have to be revised to accommodate this change. One major change we made to our computer-version template after some lessons had been written was the addition of screen numbers to identify each computer screen. We decided this was vital for tracking revisions and for locating where we were. It took time to add the screen numbers, but we decided it was worth the effort.

4. Maintaining and Updating Lessons

Recommendation: The ID team should provide methods for future updates and maintenance of the courseware.

Eventually, the lessons will need to be changed. Information will need updating; instructors will want to reorganize the content, shift the emphasis of a lesson, or add other topics. Usually, the people who develop the lessons won't be available to make these changes. So, part of the courseware development effort must include creating directions for future lesson maintainers so that they can make changes efficiently.

Some courseware provides built-in features for making changes and additions. Directions for lesson maintenance are often included in a teacher's manual. Other lessons, such as those created in the NAVPERSRANDCEN effort, provide separate software and instruction manuals, necessary because the authoring system manual did not include sufficient help for editing lessons. In either case, it is important to plan ahead for future maintainers so that lessons can be changed as needed.

V. DEVELOPMENT PHASE

Development involves the authoring and production of the actual instructional materials. If a thorough analysis has been done and complete lesson specifications have been produced during the design phase, development should proceed smoothly. Lessons learned for the development phase address preparing to develop lessons, developing lesson content, reviewing and revising, and producing the final materials.

A. WORKING EFFECTIVELY WITH THE SMEs

Recommendation: If the lesson specifications are not detailed enough, the SMEs should be asked in writing for additional examples and instructional strategies.

Sometimes lesson specifications are not sufficiently detailed. The SMEs are the best sources for additional examples, practice items, and descriptions of teaching approaches for some lesson topics. SMEs should provide much of the actual wording of the lessons and from their experience can provide many suggestions on which topics need more attention or explanation to make them clear to students.

Recommendation: A signoff procedure should be established whereby the SME or SME coordinator formally signs and dates approval of each lesson.

As the ID team and SMEs review the lesson materials, the team should establish a procedure for documenting the SME's approval of each lesson. This approval process will help instill a sense of involvement and ownership as well as accountability by the SME or SME coordinator. The signer should be the SME with final approval authority. Signoffs on drafts will also serve as documentation of progress.

Recommendation: A detailed log of contacts between the SMEs and the IDs should be kept.

Both the SMEs and IDs should keep a log of each contact with one another throughout the entire SE/ISD process, but it is particularly important during the development phase. This log should contain brief summaries of the date, duration, and content of the contact, and whether any

action was necessary as a result of it. These data are valuable because they document what has been done and provide guidance for future efforts.

B. DEVELOPING LESSON CONTENT

Recommendation: Lesson authors should become thoroughly familiar with the subject matter before beginning to write and must closely review the lesson specifications for content and method of presentation.

Lesson authors should also review any other source materials such as readings or videotapes of any current classroom instructions. If the content is particularly complex and if the ID team has enough time and resources, lesson authors should attend classroom lessons on the subject matter or be taught.

Recommendation: Descriptive examples and practice items should be used whenever possible throughout lessons.

Some of the students who evaluated our lessons commented that they preferred having a wide variety of examples, including what we called Practice and Feedback items. If time had allowed, we could have included more examples. It would not have had a negative impact on the time required for learners to finish the lesson, since lessons were structured so that learners could choose whether or not to review all examples.

The creation of good examples usually depends on subject matter expertise and can sometimes take a great deal of time. The ID might need to actively elicit such information from the SME. The SME will often be the best source about which concepts need elaboration, the kinds of questions students ask, and the kinds of explanations that clarify most effectively. One approach used is to introduce a concept, define it, provide an example of the concept, and then an example of what the concept is not. Other examples may be necessary to help the student discriminate the new concept from others learned.

Recommendation: Graphics should be used where appropriate throughout the lessons.

Pictures, illustrations, and figures can be motivating in a lesson. However, the graphics should accomplish specific instructional purposes, such as illustrating critical points or clarifying difficult concepts. Graphics should not be used as "fillers" or they could become distractions to the lesson objectives. Incorporating a variety of terms or concepts into a graphic can be an effective mnemonic educational device, but accomplishing this often requires inventiveness and expertise.

Even when a proficient graphics person is available, graphics require time to create. A screen of graphics will take longer to create than a screen of text. Our lessons might have been enhanced with more graphics, such as pictures of documents or copies of them provided in appendices; however, time was limited and other priorities took precedence.

Recommendation: Using the right words is essential.

Selecting appropriate terminology may be difficult when prospective learners represent a broad range of experience and knowledge. An extensive glossary or mini-dictionary may be needed by the novice learner. When the medium is printed materials, the reader needs to be reminded periodically that a glossary is available. For computerized lessons, it is helpful if the glossary can be accessible from any level of the lessons.

Recommendation: Students need variety in lesson presentation to stay interested and awake.

First and foremost, information must be presented in a context that the learners will understand and find useful. The learner should be encouraged to exercise cognitive skills similar to those used in a real-world setting. Periodically the student should be reminded about the importance of the information and how it fits into the bigger picture.

Some relevant application or exercise should be interjected from time to time to motivate learners to use these materials. A sprinkling of humor can also be effective in motivating the student to continue.

Recommendation: Interaction between the learner and the materials is critical to the learning process.

As the developers review each page or screen, they should ask questions such as:

1. What does the learner know so far?

2. How many facts or concepts have been presented since the learner last interacted with the materials?

3. Is it time for an exercise or an example?

4. How can the user be questioned on the content or otherwise made an active participant in the lesson?

Recommendation: Lesson objectives should be periodically rechecked.

As lessons are developed, lesson specifications should be periodically reviewed to ensure that the material is clearly tied to the objectives.

Recommendation: Overall content and presentation should be finalized as early as possible.

This recommendation is especially important if two versions of the lesson materials are being developed. If major content changes are made after both the versions are in production:

1. The work is doubled. For example, *both* print and computer versions must be fixed.

2. The chance of error is increased. A change made in the print version might be overlooked in the computer-based version.

Recommendation: If both print and computer-based versions are to be developed, develop the print version first.

The method that worked the best for us was to finalize the material in the print version before starting the computer-based version. We make this recommendation for the following reasons:

1. Development of computer-based lessons is expedited by "reading" (copying) the finalized content of the print version into prepared templates for computer storyboards, thus allowing more time for screen design and incorporation of interactivity.

2. Working in a word processor is often simpler than working in an authoring system for developing computer-based instruction. As mentioned earlier, extra time must be planned for developing computer-based lessons due to programming and branching requirements. Major changes to lesson structure are often more laborious to make to computer-based lessons than to print lessons. Also, all changes made to computer-based lessons require added time for the authoring system to compile the revisions, and for the author to then look at them on the computer to see them from the student's point of view.

C. REVIEWING AND REVISING

The key to successful review and revision is creating a systematic, standardized procedure for identifying and tracking all review/revision changes.

Recommendation: Sufficient time should be set aside for revision.

It is almost impossible to overestimate the time allowed for the review/revision process. No matter how much time is planned, it will take longer. Realize that time must be set aside for transferring documents or computer disks from the developer to the reviewer and back again a number of times to ensure that all changes have been examined and all concerns addressed.

The review and revision cycle can occur four or more times before instructional materials are completed. Time must be allowed for revisions after internal reviews, after SME reviews, and after both formative and summative evaluations. Also, practical issues such as fixed deadlines are always going to be involved. During our development effort, some of the suggestions from the formative evaluation, although valuable, could not be acted upon because of time limitations.

Recommendation: A stopping point to the revision cycle should be decided on in advance.

Although there always seems to be one more improvement that could be made, schedules must be met. In anticipation, the final revision process should be set well in advance of this date. Alternatively, the ID team can decide in advance to stop the process after a certain number of iterations. However, both of these limitations should be overridden if the materials have not met quality standards. In other words, quality must not be sacrificed, but some reasonable stopping point must be chosen beyond which no further changes will be made.

Recommendation: The review/revision cycle should be structured.

Before beginning the review and revision process, a written plan or flow chart should be created that schedules who reviews the materials first, second, third, and so on, and how many cycles there will be. One possible review/revision plan is presented in Appendix H.

Recommendation: A standardized review/revision form should be designed for use during the review/revision cycle.

This form can be used by all reviewers to record their suggestions for change. See Appendix I for an example of such a form. A standard way to describe changes may also be specified. Some developers use proofreader's marks; others develop their own in-house conventions. Such standards can lessen or eliminate the need to ask one another, "What did you mean here?" or "Where is this error?"

Following are some suggestions for items that might be included on a review form:

1. *Location of change*. The form could include space for describing the location of the change, such as the page number (for a print document) or the screen number (for the computer-based version).

2. *Type of change*. A coding system could be established (similar to proofreader's marks) to describe what change to make.

3. *Version(s) to change*. The form could ask whether the change is to be made on the computer version or print version or both. For example, some simple format changes will apply only to one version. Content changes will apply to both versions.

4. *Date when change is completed.* The form should provide space to indicate the date the change was made and the person who made the change.

Recommendation: Changes between computer and print versions must be coordinated.

After any reviewer has evaluated *either* the print or the computer version, the comments should be checked against *both* versions of the lesson. Major content items should be consistent between versions--however, it is up to the ID team to determine if it is necessary for both versions to be exactly the same, including non-crucial wordings.

D. PRODUCING THE FINAL MATERIALS

Recommendation: Enough time must be allowed for final processing of materials.

Although there may be a tendency to work up to the last minute to incorporate possible improvements, time for final processing must be scheduled. Making copies of print documents takes time, especially if the printing facility has many customers. Where possible, the job should be scheduled in advance.

If computer-based lessons are being developed, time is needed for making disk copies, which may include formatting a large number of disks. These disks should be randomly tested to ensure that they work properly. During our effort a batch of faulty disks resulted in inoperable lessons that went undiscovered until the formative evaluation.

The ID team should make sure enough disks will be on hand at the critical time. They need to be labeled consistently, perhaps using color to identify the disks that belong to a specific lesson.

Recommendation: Coordinators (especially those at remote sites) will not generally want to photocopy materials. But if time or cost considerations make this necessary, coordinators need precise instructions.

For example, coordinators should be instructed not to make two-sided copies if question and answer pages will end up facing each other. Alternatively, lessons can be designed so that all answers appear at the end of the lessons rather than immediately following the questions.

Recommendation: When materials are to be mailed, information for the coordinator should be placed on the top of the other materials, perhaps in an envelope marked "READ THIS FIRST."

This is especially important when lesson materials have several parts or sections. Large boxes filled with several types of booklets and disks and forms can discourage even the most

willing coordinator. Also, a list of the contents should accompany each batch of materials so that the coordinator knows everything has arrived.

VI. EVALUATION PHASE

In the evaluation phase of the SE/ISD process, the courseware developed is assessed by conducting both formative and summative evaluations.

A. FORMATIVE EVALUATION

In some sense, the formative evaluation might be considered as part of the development phase, since the results of this evaluation are used to further revise the materials to improve the effectiveness of instruction. The formative evaluation is conducted to discover both minor and major problems in the materials and to find out how well the lesson materials work. The instructional materials are presented to representative members of the target population in a setting that closely resembles the future learning situation. The learners serve as trial users of the materials to uncover any problems that might still exist. For example, do the learners have any special problems in following the lesson structure? Are the ideas expressed clearly? How long does it take to complete a lesson? Did the learners have any content questions after completing the lesson?

The following discussion is based on our evaluation method, which involved gathering data through feedback survey forms from evaluators in several cities. Our lessons learned focus on preparing for the evaluation, tracking the evaluation, and evaluating feedback.

1. Preparing for the Evaluation

Recommendation: Objectives of the evaluation must be defined.

There are likely to be questions asked about the materials that interest the ID team more than others. Whether the evaluation is conducted in person, in groups, or from a remote site, the ID team members must be clear in their own minds about the kinds of information that need to gathered. They should concentrate on questions that will elicit answers useful for revising the lessons. For example, participants should not be asked if they would rather not learn about a particular subject if they have no choice in the matter.

The ID team should anticipate what answers are likely and consider what changes might have to be made based on those answers. Open-ended questions, multiple choice, and survey questions that ask evaluators to choose a point on a continuum are all useful. Questions that force evaluators to make a choice are preferred over those that permit them to select some middle ground position.

Only one or two general "How did you like it?" questions should be asked. General testing procedures should be followed, such as mixing the questions so that participants don't form a response set (such as choosing all 1's or 5's or 10's on a 10-point continuum).

Recommendation: A plan should be established for dealing with the feedback results.

The plan should address who receives the feedback results, the amount of time set aside for revision, the number of comments of a certain type that should warrant a change, etc. When the time comes to actually implement these plans, these early decisions may be modified or reversed, but the effort was not wasted. Thinking about these issues helps shape the evaluation and can even affect the kinds of questions asked during the evaluation.

Recommendation: When preparing materials for evaluation, the job of the site coordinator should be made as simple as possible.

A coordinator in this case is someone (perhaps at a remote site) who has volunteered to find students/evaluators willing to use the new training materials in a systematic way and to provide feedback on these materials. The coordinator probably already has a full schedule and does not have time to take care of unanticipated problems. The training/testing site situation should be considered ahead of time to anticipate both student and coordinator needs and questions. These needs should be met in the materials provided.

a. Written Instructions

The ID team should prepare instructions for students/evaluators that describe the purpose of the evaluation and tells them what to do. This will save coordinator time and provide a somewhat standardized overview of the effort to all participants.

b. Evaluation Forms for Interviewers or Evaluators

A sample of instructions to help coordinators organize their efforts is included in Appendix J, and a sample of an evaluation form we used is provided in Appendix K. The form provides opportunities for both open-ended and forced-choice responses. This option takes into account individual differences in response style.

Recommendation: An early deadline should be set for return of materials.

The deadline set should be one that gives evaluators a reasonable amount of time to do the evaluation but yet is actually earlier than required. Even the most willing coordinators are likely to be late since they are dealing, in turn, with people who may be late completing the lessons.

2. Conducting and Monitoring the Evaluation

Recommendation: Careful records should be kept of contacts with coordinators from remote sites.

All attempts to contact coordinators should be recorded. This information is useful in reviewing the whole process and can provide the basis for commendation of coordinators for exemplary efforts.

If the evaluation takes place over a period of weeks or months and if the students are working, per direction, at their own pace, weekly or biweekly calls should be made to all evaluation sites to inquire about any possible problems. If time and resources permit, evaluation sites should be visited to observe students at work, to compare the setups at the various sites, and even to interview some of the evaluators.

3. Evaluating Feedback

Recommendation: Sufficient time must be set aside for revisions based on the evaluation feedback.

Recommendation: SMEs should be involved in evaluating feedback.

We received some contradictory opinions about the same lessons. One evaluator thought a particular lesson was clear, concise, and useful, while another thought it was vague, confusing and a waste of time. It is difficult to determine which comments to heed. SMEs are particularly helpful at this stage in trying to determine how to revise the instructional materials, at least regarding content issues.

Determining what feedback to incorporate into the lessons often depends on the time available for revisions and the quality standards set for the lessons. Of course, obvious content errors, computation errors, and repeated comments about unclear concepts should be addressed. But most other lesson elements are up to the discretion of the development team.

B. SUMMATIVE EVALUATION

In a summative evaluation, the concern is for validating the materials. This means, is the student performance and achievement on the new materials comparable or superior to that on the old? Summative evaluations usually involve a larger number of students than the formative evaluation, and include formal testing procedures, control and experimental groups, etc.

Recommendation: Coordinators/facilitators and the students should be provided with the same sorts of aids and forms as provided during the formative evaluation.

The coordinator forms and evaluator feedback forms described in the formative evaluation can be revised, if necessary, and used for the summative evaluation as well. Since the objectives of the summative evaluation are somewhat different, questions and instructors may change, but the basic intent of both sets of forms is the same--to simplify the coordinator's efforts and elicit feedback from the students.

Recommendation: If possible, evaluation sites should be chosen that offer some sort of motivator to students and other reviewers/evaluators so that they are eager to cooperate.

Evaluators need some motivation to participate--whether it be course credit or recognition of some sort, such as a certificate of achievement. The sites chosen should be encouraged to develop a motivational system if one is lacking. It is unlikely that students will spend more than a few short hours actively learning material that will serve no useful purpose to them.

Recommendation: When comparing a transportable course with a resident one, an agreement with the resident institution should be set up so that the final evaluation test is administered to a sufficient number of students.

Resident teaching institutions often experience changes in personnel, in management direction, and in course schedules. A written agreement is, therefore, important to guarantee that students can be tested with a particular instrument.

Recommendation: Adequate information about the learner's past educational and job experience should be collected.

The learning settings for resident courses and transportable ones vary radically. Learners who use transportable materials will often be able to use them at any time of day and under diverse conditions. The learner's past educational and job experience might be the one variable that must be considered when evaluating final performance data between the two groups. At the least, learners with less relevant education and experience can be expected to take longer to complete the lessons.

Recommendation: To offset the impact of attrition, at least 20 percent more students than needed should be scheduled to test the materials.

Despite all good intentions, a number of the students who originally agree to test the instructional materials will find it impossible to begin or to complete the process. This happens more frequently when lessons are to be completed over a period of several sessions or days. If the sample is larger than needed, the impact of these dropouts on evaluation will be negligible.

VII. CONCLUSIONS

This "lessons learned" document is organized around recommendations that grew out of the NAVPERSRANDCEN experience with print and computer-based media. The reader is directed to the selected references in Appendix B for guidance on how to work effectively with other media such as interactive video.

Our experience makes clear that the development of transportable instructional materials is a complex process requiring extensive planning. A team effort is required to accomplish the many tasks at hand. To do them all successfully, ID team members must collectively represent a wide range of skills.

Transportable courseware makes good sense any time, but as funding within the Department of Defense continues to shrink in response to changing world conditions, it makes even more sense. Transportable materials reduce the need for residential classrooms and a large faculty. They permit education to go on in any environment and for larger numbers of people. No longer should students have to leave their work place to travel long distances to receive training. And instructors have the best of both worlds. Now they have the ability to standardize education and at the same time adapt it to meet individual needs.

VIII. REFERENCES

Clark, R. E. (1985). Evidence for confounding in computer-based instruction studies: Analyzing the meta-analyses. *ECTJ*, *33*(4), 249-262.

Clark, R. E., & Sugrue, B. M. (in press). American disputes about research on learning from media. *International Journal of Education Research.*

APPENDIX A

SYSTEMS ENGINEERING FOR INSTRUCTIONAL DEVELOPMENT (SEID) PROCESS

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SYSTEMS ENGINEERING FOR INSTRUCTIONAL DEVELOPMENT (SEID) PROCESS

This appendix presents a brief description of the phases in the Systems Engineering for Instructional Development (SEID) process. The literature cited in Appendix B provides in-depth discussions of the SEID process and the more generic Instructional Systems Development (ISD) process.

1. Analysis

The goal of the analysis phase is to determine what and who needs to be taught. During this phase, analysts review the current operations of a job or learning task to determine if there is an instructional problem. If it is determined that improved training is needed, the focus shifts to the specific tasks that need to be trained.

The learner population is also assessed to determine who they will be, what they already know, and what they need to know. In addition, the learning situation (e.g., job site) is examined to assess its conditions and the resources available. Management issues are also considered, including management tasks, responsibilities, and time lines. Based on these reviews, analysts determine what needs to be changed in the existing education or training program. The goals, constraints, and priorities of the instructional program or products are then established. The products of the analysis phase generally consist of task descriptions, course learning objectives, and course prerequisites.

2. Design

Once the analysts have determined what instruction is needed, the goal of the design phase is to determine how the instruction will be performed. The goals, constraints, and priorities developed in the analysis phase are clarified and made specific.

The designer's role is to determine the most appropriate media for instruction, methods of instruction, specific content of instruction, and time estimates. The designer must also determine instructional strategies (including response and feedback strategies as well as sequence of presentation), assessment strategies, and management strategies for collecting, reporting, and using the collected data.

The final products of the design phase are lesson specifications that document the presentation and evaluation strategies. These specifications include prerequisite learning, lesson structures, presentation strategies, examples, evaluation strategies, and reviewer guidelines.

They also provide detailed instructional objectives, with test items written to match these objectives. The specifications provide the lesson authors, graphic artists, and other instructional design specialists with the information needed to develop the final learning materials. These specifications are designed at a very detailed level to ensure that lesson authors do not have to be subject matter experts.

3. Development

After the analysts and designers have defined and outlined what will be taught and how and when and why, the instructional authors create the actual instructional materials. All parts of the materials are based on the media, methods, and instructional strategies outlined in the lesson specifications. It is during the development phase that scripts and storyboards are written, graphics and other pictorial illustrations are created, and lesson materials and programming for computer-based courseware constructed. If any flaws or omissions occurred during the analysis and design phases, they will show up at this phase. Making corrections to analysis and design problems can delay the completion of this phase of the process.

4. Implementation

During the implementation phase, the instructional materials are presented to students and instructors in the field. The goal of this phase is to ensure that a valid learning program is established, maintained, and improved over time. This is accomplished by: (a) examining implementation performance data and experiences, (b) incorporating anecdotal instructor experiences that are encountered, and (c) incorporating feedback from learners and their job supervisors.

5. Evaluation

The evaluation phase involves conducting the formative and summative evaluations of the instructional materials.

The purpose of a formative evaluation is to gather information about the readability and understandability of the material, the ease of use, instructional goodness, and so on. A formative evaluation can involve a small sample of people, such as students who represent the target population, or sometimes only subject matter experts. Although potential students are an excellent source of feedback, sometimes the formative evaluation is conducted instead with experienced teachers or job-holders--another kind of subject matter expert in the field. Formative evaluation involves either small-group or full-group operational trials of the instructional materials. This phase of evaluation is often conducted BEFORE the courseware is implemented, so that the revisions based on this evaluation can be included in the fielded lessons.

Formative evaluations can consist of individual interviews, group interviews, or surveys (sending feedback forms to remote sites for students to complete). Results from all of these methods have been shown to be comparable, though they differ in cost, with individual interviews being the most expensive in terms of time and personnel resources and the survey/feedback form method being the least expensive.

Summative evaluation consists of evaluation of performance data and feedback from graduates of the courseware as well as development of "lessons learned" by the ID team. The goal of the summative evaluation is to determine the value or worth of the instruction. Performance data typically include the results of criterion-referenced assessment instruments that measure student mastery of lesson objectives. The evaluators, along with the subject matter experts, review the performance data and the feedback and determine if the materials are adequately communicating what needs to be taught.

Whereas the formative evaluation is expressly conducted to gather data to revise the materials, the summative evaluation is conducted to determine the value of the materials for a particular subject population or a particular learning setting, or both. The analysis includes how well the content has been covered, how well the objectives of the lessons have been met, and the relationship between the test instruments and the objectives. All of these evaluations can trigger revisions in course presentation or evaluation.

APPENDIX B

SELECTED REFERENCES ON INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD)

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SELECTED REFERENCES ON INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD)

Alessi, S. M., & Trollip, S. R. (1985). *Computer-based instruction: Methods and development.* Englewood Cliffs, NJ: Prentice-Hall.

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Gagne, R. M. (1985). *The conditions of learning and theory of instruction* (4th ed). New York: Holt, Rinehart & Winston.

Gagne, R. M. (Ed.) (1987). *Instructional technology: Foundations.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Heinich, R., Molenda, M., & Russell, J. D. (1982). *Instructional media and the new technologies of instruction.* New York: John Wiley.

Jonassen, D. H. (1988). *Instructional designs for microcomputer courseware.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Kearsley, G. (1986). *Authoring: A guide to the design of instructional software.* Menlo Park, CA: Addison-Wesley.

Reigeluth, C. (Ed.) (1983). *Instructional design theories and models.* Hillsdale, NJ: Lawrence Erlbaum.

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APPENDIX C

SAMPLE LESSON SPECIFICATIONS

LESSON SPECIFICATION

LESSON NUMBER REM 01

LESSON TITLE Introduction to Funds Management in the Department of Defense

HOURS OF INSTRUCTION Transportable - 3 hours

MEDIA Self-Paced Print and Computer-Assisted Learning (CAL)

PREREQUISITES

The learner should have completed DAEP Lessons 1 through 6 and TPM Lessons 1 through 3 before starting this lesson.

LESSON MAP This is the first lesson in a series of six REM lessons. REM 01 is a three hour lesson composed of six segments to be taken in sequence as shown below:

Segment 1	The Historical Legal Basis of Federal Budgeting.	.25 hr.
Segment 2	Monetary Concepts Related to Budgeting	.50 hr.
Segment 3	Methods and Techniques of Cost Estimating	.50 hr.
Segment 4	Learning Curve	1.0 hr.
Segment 5	Life Cycle Cost Management and Design to Cost Management in Relation to Cost Estimating/Budgeting	.50 hr.
Segment 6	Management Reserve	.25 hr.

LESSON INTRODUCTION

The funding of defense systems acquisition has its basis in the Constitution and subsequent laws enacted by Congress. Funds management is a continuous process within the Program Office. Budgeting data is used for budget submissions for funding and for continuous "reality checking" within programs. Cost estimations provide the basis for making budgeting decisions.

LESSON OBJECTIVES

1. Briefly explain the historical legal basis of Federal budgeting. (3.1.1)

2. Identify definitions of monetary concepts related to budgeting and their sequence: Budget Authority, Commitment, Certification, Obligation, Cost Incurrence, Expenditure, Outlay. (3.1.2) (**Note:** This is a brief introductory segment to introduce these terms; additional information will be taught in REM 05)

3. Identify explanations of the following methods and techniques of cost estimating and the primary use of each: Analogy, Parametric, Engineering, Extrapolation from Actuals, and Price Lists. (3.1.3)

4. Given appropriate data, determine learning curve lot midpoints using graph (curved line and log-log) solutions. (3.1.4)

5. Explain Life Cycle Cost Management and Design to Cost Management in relation to cost estimating/budgeting. (3.1.5)

6. Explain the term "management reserve", including its need in cost estimates. (3.1.6)

COMMON ERRORS

1. The concepts (Commitment, Certification, and Obligation) are often confused. (Segment 01.2)

2. The concepts Expenditure and Outlay are commonly used interchangeably. They are also commonly misused in the "field". (Segment 01.2)

3. The learner will often want to use just one cost estimating method, when in actuality all could be used to determine estimate correlation. (Segment 01.3)

ITEM PRODUCTION

Practice items and test items will consist of fill-in-the-blank, true/false, short answer, and listing types of items formatted into multiple choice questions. Example items will be constructed in support of the segment generalities. The number of example, practice, and test items for each segment are shown in the matrix below.

	ITEMS		
SEGMENTS	EXAMPLES	PRACTICE	TEST
Segment 1	N/A	1	2
Segment 2	N/A	2	4
Segment 3	N/A	4	8
Segment 4	2	3	6
Segment 5	N/A	3	6
Segment 6	N/A	1	2

LESSON AUTHOR REFERENCES

Teaching Notes

- Teaching Note: Cost Estimating Methodologies (Jan 88)
- Teaching Note: Parametric Cost Analysis (Jan 88)
- Teaching Note: Cost Quantity Relationships "Learning Curve Theory (Jan 88)
- Teaching Note: Life Cycle Cost Management (Jan 88)
- Teaching Note: President's Budget Submission, Congressional Authorization and Appropriation [from REM 04] (Jan 88)

DoD Directives/Instructions/Standards

- DoDI 5000.33 - Uniform Budget/Cost Terms and Definitions (15 Aug 77)
- DoDD 4245.3 - Design to Cost (6 Apr 83)

Articles/Books

- Troy Caver, "Life Cycle Cost: Attitudes and Latitudes", Defense Management Journal, July-August 1979.
- J. Witt, "Life Cycle Cost Analysis", Technical Perspective, May 1974.
- J. Underwood and B. Retterer, "Design to Cost", Technical Perspectives", October 1976.

- A Glossary of Terms Used In The Federal Budget Process, U.S. General Accounting Office, March 1981.

Example Documents

- Prototype Lesson BREM 09 (The Prototype Lesson BREM 09 was developed in 1987 under a previous contract by Instructional Science and Development, Inc. (ISD) for the Navy Personnel Research and Development Center (NPRDC) and the Defense Systems Management College (DSMC).)

SEGMENT SPECIFICATION

SEGMENT NUMBER REM 01.1

SEGMENT TITLE The Historical Legal Basis of Federal Budgeting

SEGMENT OBJECTIVE

1. Briefly explain the historical legal basis of Federal budgeting. (3.1.1)

OBJECTIVE TYPE

1. Remember/Concept

GENERALITY

1. The following legal documents provide the legal basis of Federal Budgeting:

   - The Constitution provides that financial policy is the responsibility of Congress. Article I, Section 9 states, "No money shall be drawn from the Treasury, but in Consequence of Appropriations made by law...". Appropriations are a part of an Appropriation Act or an act of Congress that provides a specified amount of budget authority (authority to enter into obligations which generally result in immediate or future disbursements of Government funds).

   - Budgeting and Accounting Act (1921) set up the requirements by which the Executive Branch prepares and submits the budget to Congress.

   - Congressional Budget and Impoundment Control Act (1974) changed the fiscal year, required that Congress look at spending and revenues, and established a timetable for budgeting activities.

   - Gramm-Rudman-Hollings Act (1985), as revised, established an automatic deficit reduction mechanism, revised the budgeting timetable, and streamlined the process of passing the budget.

ITEM PRODUCTION

	ITEMS		
OBJECTIVES	EXAMPLES	PRACTICE	TEST
Objective 1	N/A	1	2

EXAMPLE/HELPS

1. Refer back to DAEP 03 where laws affecting the federal acquisition process were learned. The laws in this lesson (REM 01.1) affect the financing of federal acquisitions.

SAMPLE PRACTICE ITEM

1. The act that established a "deficit reduction mechanism" was the _____.

   a. Budgeting and Accounting Act
   b. Congressional Budget and Impoundment Control Act
   * c. Gramm-Rudman-Hollings Act
   d. Armed Services Procurement Act.

SAMPLE TEST ITEM

1. The Constitution states, "No money shall be drawn from the Treasury, but in Consequence of _____..."

   a. Authorizations
   b. Budget Authority
   * c. Appropriations
   d. Allocations

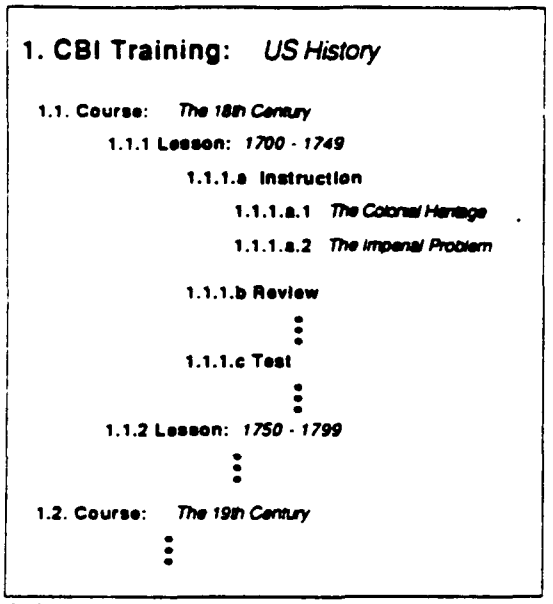
GRAPHIC SPECIFICATIONS

1. Introduction graphic: Constitution

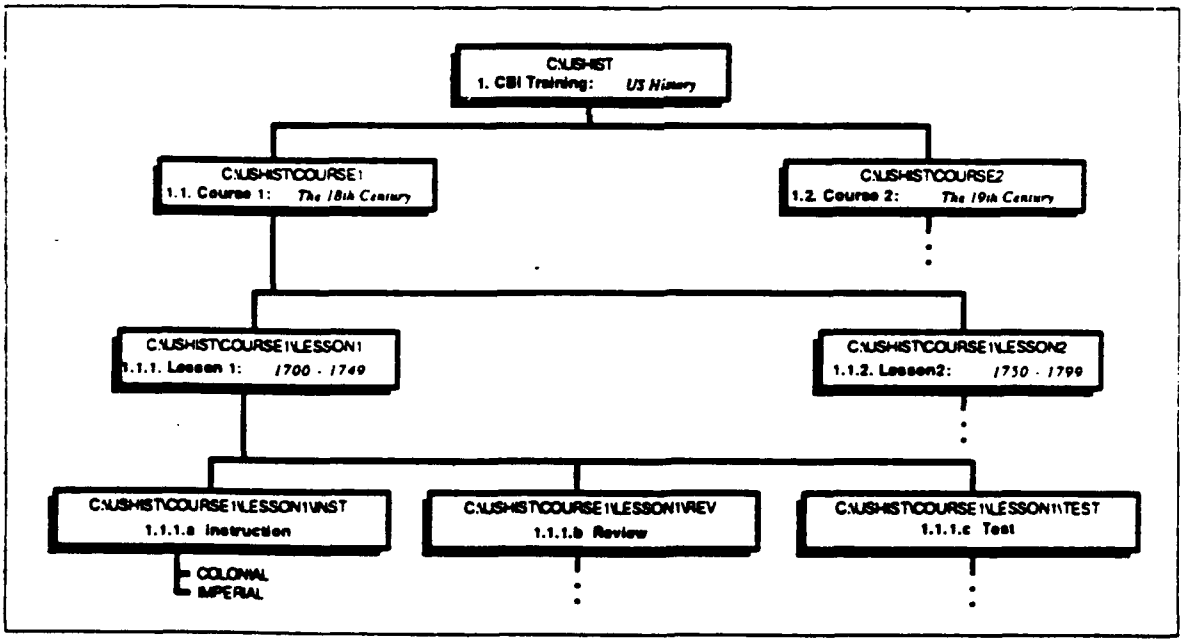
2. Progressive disclosure of 1) Constitution, 2) 1921, 3) 1974, and 1985

APPENDIX D

SAMPLE DIRECTORY STRUCTURE FOR ORGANIZING COMPUTER FILES



(a)



(b)

Figure 5. Sample: outline (a) and corresponding directory tree (b).

APPENDIX E

STRUCTURE AND NAMING CONVENTIONS FOR PRINT, COMPUTER-BASED, AND GRAPHICS FILES FOR THE FUNDS MANAGEMENT (FM) LESSONS

EXAMPLE STRUCTURE AND NAMING CONVENTIONS

DIRECTORY STRUCTURE AND NAMING CONVENTIONS

Directory structure should reflect the hierarchy of your courseware structure.

Directory Level 1: Name top level directory the name of the course: FM

Example c:\FM

Directory Level 2: Name the second level directories the name of the lesson: FM1, FM2, FM3, FM4, FM5

Example c:\FM\FM1

Directory Level 3: The name of the directories corresponding to areas within or version of a lesson.

KEY: X = lesson name
Y = segment number

1.	FMXPT	Directory for Print Version
2.	FMXUG	CAL User's Guide Directory
3.	FMXSA	CAL Introductory Information Directory
4.	FMXSB	CAL Function Keys Directory
5.	FMXSY	CAL Segment Directories

Example c:\FM\FM1\FM1UG (directory for the FM1 CAL User's Guide)

FILE STRUCTURE AND NAMING CONVENTIONS

The following naming conventions are examples used from the Funds Management (FM) lessons.

Print Version Files

KEY	
X	lesson number
Y	letter (A, B, C, etc.) indicating file sequence
Z	segment number or letter for working files

Examples

FMX.PT Name of final print version file, if only one file is needed

Example FM1.PT FM lesson 1 print version file

FMXY.PT Name of final print version files, if one file cannot fit onto a floppy disk, where Y = A, B, etc. indicating lesson part.

Example FM1A.PT FM lesson 1 print version file, part A (file does not contain the entire lesson 1)

FMXSZ.PT Name of working files for segments (optional)

Example FM1S1.PT FM lesson 1 print version working file for segment 1.

CAL Version Files

KEY	
@	functional area
#	lesson number
$	segment number
%	current menu selection number (cmsn)
?	page number, general number

FM directory top level directory for FM lessons

FM# directory directory for a specific FM lesson (example: FM3 for FM lesson 3)

build.bat	batch file for compiling storyboards
qbuild.bat	"quick" batch file for compiling segment files
distrib.bat	batch file for creating lesson distribution disks
cvarsf@	file defining variables used for a lesson (for authoring system): For Lesson FM 3, variables would be defined in file "cvarsf3"

FM#SA directory

initial	file for initializing variables
intro	lesson introductory graphics
calop	CAL operating procedures
lesorg	lesson organization information
lesio	lesson introduction and objectives
pre	pre-quiz
post	post-quiz
build.bat	batch file for compiling storyboards
qbuild.bat	"quick" batch file for

	compiling segment files
*.pic	all graphic files with .pic extension for the files in the directory: "*" is wild card symbol
*.cut	all graphic files with .cut extension for the files in the directory: "*" is wild card symbol

FM#SB directory

calf1	function key 1
calf2	function key 2
calf3	function key 3
calf4	function key 4
mainmenu	main menu function key
calf6	function key 6
calf7	function key 7
calf8	function key 8
calf9	function key 9
calf10	function key 10
build.bat	batch file
qbuild.bat	batch file
*.pic	graphic files with .pic extension for files in the directory
*.cut	graphic files with .cut extension for files in the directory

FM#S$ directory

@#$m	segment menu: f31m (segment menu for lesson FM 3, segment 1)
@#$io	segment introduction and objectives
@#$ci	segment "Core" information
@#$mi	segment "More" information
@#$e	segment "Example"
@#$s1	segment "Summary," one screen
@#$s2	segment "Summary," more than one screen
@#$p1	segment "Practice," one item
@#$p2	segment "Practice," more than one item
build.bat	batch file
qbuild.bat	"quick" batch file

*.pic	graphic files with .pic extension for directory
*.cut	graphic files with .cut extension for directory

Graphics Files

The graphics also need to be named in a logical manner, especially if they are to be imported from an external graphics program. Often, the graphic will exist with two different names -- and the extension can sometimes be the feature that can distinguish between the graphics program version and the word processor or authoring system version. Special requirements need to be considered when including a graphic in either a word processor or in an authoring program.

The examples below present templates for file names of Dr. Halo III graphics, and the Word Perfect graphic converted from the Dr. Halo graphic for print versions.

KEY

@	functional area
#	lesson number
$	segment number
%	current menu selection number (cmsn)
?	graphic number, general number
x	lesson sections, where x can be:

i	Introduction and Objectives
c	Core information
m	More information
e	Examples
s	Summary
p	Practice items and feedback
q	Quizzes (pre and post)

.pic	extension for Dr. Halo full screen graphic
.cut	extension for Dr. Halo partial screen graphic
.wpg	extension for Word Perfect graphic (converted from the Dr. Halo .pic graphic

@f$x?

Example: F31C2.pic, F31C2.cut, and/or F31C2.wpg

where:
F = an FM lesson
3 = Lesson 3
1 = Segment 1
C = for Core information
2 = graphic 2 in the Core information file

F31C2.pic is a Dr. Halo full screen graphic

F31C2.cut is a Dr. Halo cut graphic

F31C2.wpg is a the Word Perfect graphic converted from the Dr. Halo .pic graphic.

APPENDIX F

SAMPLE FORMAT STANDARDS FOR DEVELOPMENT OF PRINT LESSONS

FORMAT GUIDELINES

PRINT AND CAL USER'S GUIDE VERSIONS

v1 24 May 1989

Margins	Preset
Page Numbering	Preset
Footer A	Set to FM 0X0. Change to appropriate X.
Footer B	Generic footers preset. Change Segment footer to appropriate X on page 1.
Indent	Preset. Use indent rather than tab for 'hanging' info, e.g., questions, lists, glossary, etc. Change tabs only for special cases, e.g., table, then change back to original.
Tab	Preset. Change tabs only for special cases, e.g., table, then change back to original.
Fonts	Helv 12 is the base font. Only first order headings are Helv 14 pt. **Suggestion:** To bold titles, words, etc. use F6, then you don't have to use Ctrl F8 to change fonts and then change back. **Exception:** Lesson and Segment objectives have been preset to Helv 12 bold.
Headings	**First order** Helv 14 bold, caps, centered, top of page 6 HRTs after, 0 HRTs before **Second order** Helv 12, bold (use F6), caps, centered, top of page (e.g., Core Information) unless preset (e.g., Module Components) 3 HRTs after, 4 HRTs before (unless after first order, then 6 HRTs) **Third order** Helv 12, bold (F6), caps, left justified 3 HRTs after, 3 HRTs before **Fourth order** Helv 12, bold (F6), no caps, left justified 2 HRTs after, 3 HRTs before

X Wild Card

X denotes place for you to substitute appropriate info, or add/delete info.

Segment X

Use Segment 1 template for other segments. Change footer A. Select appropriate What To Do Next sentence at end of segment.

Table of Contents

First, second, and third order headings should be listed in Table of Contents. Add/delete headings as necessary.

First order headings	Helv 12 pt, bold (F6), caps, left justified 2 HRTs before (unless first one, then 6 HRTs)
Second order headings	Helv 12 pt, no caps, indent 1HRT before
Third order headings	Helv 12 pt, no caps, indent, indent 1 HRT before

Notes

Indent, bold (F6) the word 'Note:' or 'Notes:'
If info is especially important, then bold the info also.
For more than one note, number the notes. See CAL User's *Guide for sample.*

Single/Multiples

Make appropriate change (e.g., change EXAMPLEXS to EXAMPLE or EXAMPLES, whichever is appropriate.

APPENDIX G

SAMPLE TEMPLATE FILE FOR COMPUTER-BASED LESSON DEVELOPMENT

```
vent name: info-1  (@#$m)
********************************************** ******************************
*********************************************************************************
                                  $Segment Title                              [20
+-------------------------------------------------------------------------------

      The [1              ] section contains the information that is
      most necessary for you to learn.

          Use the[13]or[14  ]arrow keys to make a selection,
          th n press [4   ].

        +---------------MENU-----------------------------------------+
        |                        SEGMENT 1 MENU                      |
        |   $Title of Segment, not caps, centered                    |
        +------------------------------------------------------------+
        |                                                            |
        |   [ 7]   1.  Introduction and Objective                    |
        |   [ 8]   2.  Core Information                              |
        |   [ 9]   3.  More Information   (delete,if not used)       |
        |   [10]   3.  Example      (delete, if not used, plural?)   |
        |   [11]   4.  Summary                                       |
        |   [12]   5.  Practice Item and Feedback (plural?)          |
        +------------------------------------------------------------+

     [5]= Entered this menu option          [6]= Completed this menu option
-------------------------------------------------------------------------------
   F1=HELP  F2=EXIT  F3=GLOSSARY  F4=SEGMT MENU  F5=MAIN MENU  F10=SCOREBOARD
*********************************************************************************
*********************************************************************************

DISPLAY ATTRIBUTES:
footnote 20: grey/black: "$m"
line color: bright_blue
footnote 1: yellow/black : "Core Information"
footnote 4: bright_green/black  : "RETURN"
footnote 5: yellow/black: "-"
footnote 6: yellow/black: "*"
footnote 7: yellow/black: $sio
footnote 8: yellow/black: $sci
footnote 9: yellow/black: $smi
footnote 10: yellow/black: $se
footnote 11: yellow/black: $ss
footnote 12: yellow/black: $sp
footnote 13: bright_green/black  : "up"
footnote 14: bright_green/black  : "down"
text color: bright_white
menu title color: yellow
menu title background color: black
menu text color: bright_white
menu text background color: black
menu selector color: yellow
 nu selector line number: 1
```

KEY

```
@ = functional area
# = lesson number
$ = segment number
% = cmsn
? = page number, number
```

```
menu border color: bright_blue
menu background color: black
screen update: refresh

CONTROL ATTRIBUTES:
branch control
   terminating condition: cmsn = 1
   next event: @#$io (intro and objective)
   activation method: branch

branch control
   terminating condition: cmsn = 2
   next event: @#$ci (core info)
   activation method: branch

branch control
   terminating condition: cmsn = %
   next event: @#$mi(more info)
   activation method: branch

branch control
   terminating condition: cmsn = %
   next event: @#$e (example)
   activation method: branch

branch control
   terminating condition: cmsn = %
   next event: @#$s (summary)
   activation method: branch

branch control
   terminating condition: cmsn = %
   next event: @#$p (practice)
   activation method: branch

branch control
   terminating condition: (ckr = B) or (ckr = b)
   next event: pen
   activation method: branch

branch control
   terminating condition: ckr = <F1>
   next event: calf1 (help)
   activation method: call

branch control
   terminating condition: ckr = <F2>
   next event: calf2 (Exit/Save/Reenter)
   activation method: call

branch control
   terminating condition: ckr = <F3>
   next event: calf3 (glossary)
   activation method: call
```

```
branch control
   terminating condition: ckr = <F1>
   next event: @#$m (Components menu)
   activation method: branch

branch control
   terminating condition: ckr = <F5>
   next event: mainmenu (main menu)
   activation method: branch

branch control
   terminating condition: ckr = <F6>
   next event: calf6 (blank)
   activation method: call

branch control
   terminating condition: ckr = <F7>
   next event: calf7 (blank)
   activation method: call

branch control
   terminating condition: ckr = <F8>
   next event: calf8 (blank)
   activation method: call

branch control
   terminating condition: ckr = <F9>
   next event: calf9 (blank)
   activation method: call

branch control
   terminating condition: ckr = <F10>
   next event: calf10 (scorecard)
   activation method: call

MODIFICATION LOG: 7/24/89 vel
```

APPENDIX H

SAMPLE REVIEW/REVISION CYCLE PLAN

SAMPLE REVIEW/REVISION CYCLE PLAN

1. Development of Draft #1 by Instructional Developers	Instructional Developers develop the first draft (Draft #1) of a lesson using the SEID process.
2. Internal Review/ Revision of Draft #1 by Instructional Developers	Review the lesson materials in-house before sending a first draft to SMEs. Use a standardized review form throughout the entire review/revision process. A. Who Reviews. The lesson author should review the draft first. Then at least one other instructional developer should review the draft to provide a fresh viewpoint. B. What to Review For. Write standardized instructions for the review. For example, develop a checklist of specific instructions for the review process (indicating when the review must be completed), as well as what to look for when reviewing materials (rather than saying "Just note anything you'd like to be better"). Review the materials for: * **Content Validity.** Although the SME is the expert on content validity, the lesson author can review for obvious content flaws based on the materials s/he has been using to write the draft. The second reviewer should review for readability, clarity, interest, and effectiveness of examples/ practice items. * **Spelling, Grammatical Errors.** All instructional developers can review for spelling and grammatical errors. The more of these types of errors that can be flushed out during internal review, the more the SME reviews can concentrate on content validity. * **Format Issues.** Although the lesson format should have been planned during the design phase of the SEID process, actual development of the materials may reveal deficiencies in the original plan. These deficiencies can be noted and suggestions for corrections can be made during this review stage. After the internal review is complete and the revisions have been made in-house, send Draft #1 to the SME(s).
3. SME Review/ Revision of Draft #1	A. Who Reviews. If more than one SME needs to review the material, plan the sequence of which SME receives the material and on what date. As recommended elsewhere, make sure that the last SME/coordinator to review the materials is the SME/coordinator with the final approval authority. B. What to Review For. SMEs must focus on reviewing the validity of the content, structure, and presentation sequence of the instructional materials. However, SMEs should also review for the same items assessed during internal review (e.g., spelling, grammatical errors, interest, clarity, readability, etc.). Encourage SMEs to be as thorough as possible, especially in the review of the first draft. Provide and instruct SMEs to use the standardized review form and the checklist of the review/revision procedure. After the SME(s) have reviewed the draft, the review form should be returned to the lesson author for revision.
4. Internal Review/ Revision of Draft #2	After making the revisions, you might want to conduct a second internal review to make sure all the SMEs' revisions have been made, and that there are no other errors. Again, the lesson author and at least one other team member should review the materials.
5. SME Review/ Revision of Draft #2, if appropriate	A second SME review/revision may be needed if SMEs suggested major or numerous changes to the first draft. If this is the case, send SMEs another standardized review form along with the second draft. If only part of the lesson was extensively revised, you might just return that part to the SME for a second review.

APPENDIX I

SAMPLE STANDARDIZED REVIEW/REVISION FORM

DEVELOPER'S CONTENT FEEDBACK

PRINT PAGE	FIXED	CAL SCREEN #	FIXED	COMMENTS

APPENDIX J

SAMPLE COORDINATOR INSTRUCTIONS FOR FORMATIVE EVALUATION

EVALUATION COORDINATOR WORKSHEET

(To be used for each participant)

Date _____

Evaluation Coordinator Organization _____

PARTICIPANT INFORMATION:

Organization _____

Name _____

Identification number* _____

Phone number _____

Print version? _____ Computer version? _____

Location of computer _____

Is the computer a Zenith 248? See Users Guide.

Is the computer set up and loaded (by you or by one of the participants)? Yes ___ No ___

Is the schedule for computer usage time posted?

Date for participant to begin instruction _____

Supervisor who has given approval _____

Time per week available for training _____

Facilitator for this participant _____

Facilitator hours available to participant _____

*Please assign each participant a unique identification number and make sure that this number appears on all materials. For example, FE01, FE02, etc.) Please also let the participant know what this number is, so all materials can be identified.

EVALUATION COORDINATOR INFORMATION

The goal of the formative evaluation is to obtain feedback from participants on questions such as:

-- do the participants understand the content?
-- do the lessons flow well?
-- how long does it take each participant to accomplish each lesson?

A feedback form packet will be provided to each participant to gather: 1) information on some key background questions and 2) their ideas on format and content questions to improve the materials. The evaluation coordinator will complete a worksheet for each participant to help organize the administration of the lessons.

As a reminder, please do not alter any of the training materials. Present them to the participants just as they are given to you.

For the (DATE) evaluation, it would be best to have at least five but no more than ten participants complete each print version of the lessons and the same number of participants complete each computer-based version.

Facilitator help

Each participant must have someone who can serve as a facilitator to help with the lesson content, someone they can call with questions or clarifications. Facilitators should have completed the (SUBJECT AREA COURSE) or its equivalent or should have had at least (AMOUNT) of experience in (SUBJECT AREA).

The facilitator would be the first person to whom the participant would direct questions. If more information is needed, the facilitator can direct (or have participants do so) questions to the Evaluation Coordinator. The Evaluation Coordinator can contact (YOUR ORGANIZATION'S NAME AND POINTS OF CONTACT WITH PHONE NUMBERS).

Computer help for the computer-based version

--To load the training materials, refer to the Users Guide.
--For assistance, contact your local computer specialists.

TASKS FOR EVALUATION COORDINATORS

Obtain or prepare sufficient materials

EACH participant will need:
- 1 Evaluation Coordinator Worksheet per lesson (participant information, to be filled out by the evaluation coordinator)
- 1 Participant Feedback Form packet per lesson (participant feedback from lessons, to be filled out by the participant)

Each PRINT participant will ALSO need 1 Lesson Booklet per lesson

Each COMPUTER ASSISTED LEARNING participant will need:
- -- 1 Users Guide per lesson,
- -- A computer loaded with the training materials, OR a set of floppy disks so they can load the materials before beginning,
- -- A schedule when this computer is available for his/her use,
- -- 1 Student Disk for EACH lesson to be done (have the participants label their disks with their ID numbers and the lesson numbers).

It would be helpful to label each set of lesson materials with an identification number unique to each participant (and let the participant know his/her identification number), so all materials can be easily identified.

Since the lessons need to be completed and delivered to the evaluation coordinator by (DATE), some way of checking on participant progress might be necessary.

Collection of materials

After the participants have completed the lessons, the materials will be collected and mailed to (LOCATION). Materials to return include:

-- hardcopy lessons,
-- student disks,
-- feedback form packets,
-- evaluation coordinator worksheets
-- and any other materials on which participants have written comments

Please mail completed materials as they are returned to you. You may use the mailing labels supplied to you. We suggest that you send a packet of completed materials at the end of each week. THE FINAL DEADLINE FOR ALL MATERIALS to be returned to the evaluation coordinator is (DATE).

APPENDIX K

SAMPLE EVALUATOR FORM FOR FORMATIVE EVALUATION

YOUR ORGANIZATION OR PROJECT TITLE

PARTICIPANT FEEDBACK - DRAFT LESSON TRYOUTS

We are exploring the conversion of parts of the [Course Name] to a self-study option. We are evaluating draft versions of the first lessons converted to this self-study format. We are not testing your knowledge of the subject matter, but rather evaluating how well the materials actually teach. The feedback you provide on these lessons will help us improve the instruction not only for these lessons, but also for other lessons in this field.

1. Name or ID Number (ask your evaluation coordinator)

   _____

2. Job title _____

3. Work address: _____

   _____

   _____

4. Work phone: _____

5. Job Supervisor Name: _____

6. Please complete the following background information.

   Military or Civilian Grade _____

   Specialty or Occupational Code _____

   Experience in (TOPIC AREA 1) _____ years

   Experience in a (TOPIC AREA 2) _____ years

   Total Military or Federal Service _____ years

   Highest Academic Degree _____

   Military Schools (C/S) _____ (SSC) _____

   Last or Current Job Assignment _____

   Projected Next Assignment _____

8. Have you been a (SCHOOL X) student in the past? ____ Yes _____ No

   If YES, what class were you in? _____

GENERAL INSTRUCTIONS FOR FILLING OUT THE FEEDBACK FORMS:

The draft materials you have been given contain a pre-quiz, a lesson consisting of several segments of instruction, and a post-quiz. For each quiz and segment, there is a feedback form.

1. As you work on each component of the lesson, please note the time it takes you in the spaces indicated on these feedback forms. If you are interrupted, please estimate how long you actually spend on the quiz or segment.

2. As you proceed through the materials, please write any comments, questions, or suggestions directly on the pages of the lesson booklet or (if you are taking the computer-based version) on the Computer Screen Feedback sheets at the back of this packet.

3. As you complete each component of the lesson, please fill out the feedback form for that particular component. Be as specific as possible in making comments and suggestions.

4. At the end, please fill out the Overall Lesson Feedback Form.

5. If you have any problems or questions about the materials, contact your facilitator.

6. If you have any problems or questions about time available for training, first contact your supervisor. If he or she cannot resolve the problem, please contact your evaluation coordinator.

7. As you complete each lesson, please return the lesson and all of its associated materials to the evaluation coordinator. THE FINAL DEADLINE FOR ALL MATERIALS IS (DATE).

THANK YOU FOR YOUR HELP!

Now, you are ready to begin the lesson. When you have completed the pre-quiz, return to the next page of this feedback form.

SEGMENT 1 FEEDBACK FORM

Please circle 1, 2, or 3 and write comments and suggestions for each question. If you need more space, please write on the back of this sheet.

Please note your Total time _____ for completing Segment 1.

		YES	SOMEWHAT	NO
1.	Did you understand from the Lesson Objectives what you would be able to do after completing the segment? If not, please suggest how the objectives could be rephrased.	1	2	3
2.	Do you now feel you can perform the activities stated in the Lesson Objectives? If not, why not?	1	2	3
3.	Was the Core Information presented clearly? If not, how could it be clearer?	1	2	3
4.	If there was a More Information section, did it add important information? If not, what should be added or deleted?	1	2	3
5.	If there were Examples, were they clear? If you can think of any better examples, please write them here or on the back of this sheet.	1	2	3
6.	Were there any areas that could benefit from added or deleted graphics? If so, please advise.	1	2	3
7.	Were the Practice Items clearly stated? If not, how could they be stated more clearly?	1	2	3

	YES	SOMEWHAT	NO
8. Would more Practice Items be helpful? If yes, what topics should they cover?	1	2	3
9. Did the Practice Feedback adequately explain why your answers were correct/incorrect? If not, how would you rephrase it to provide better feedback?	1	2	3
10. Did you have any unanswered questions during the segment? If yes, what were they?	1	2	3

Please circle a number for each item that you feel best describes the segment. Then write comments or suggestions for each item.

1. **DIFFICULT TO FOLLOW** **EASY TO FOLLOW**
1----2----3----4----5----6----7----8----9----10
Comments:

2. **BENEFICIAL** **WASTE OF TIME**
1----2----3----4----5----6----7----8----9----10
Comments:

3. **BORING** **INTERESTING**
1----2----3----4----5----6----7----8----9----10
Comments:

4. **TOO DETAILED** **NOT ENOUGH DETAIL**
1----2----3----4----5----6----7----8----9----10
Comments:

Now go on to the next segment in your lesson booklet or on the computer.

COMPUTER-BASED LEARNING FEEDBACK FORM

1. Were you able to install the lesson without assistance?

_____ Yes _____ No _____ It was already installed

If NO, what assistance was necessary?
COMMENTS/SUGGESTIONS:

2. Were you able to use the operating procedures without help?

_____ Yes _____ No

COMMENTS/SUGGESTIONS:

3. Did you use the function keys? _____ Yes _____ No

If YES, which ones? (Please circle) Were they useful?

	YES	SOMEWHAT	NO
F1 - Help	1	2	3
F2 - Exit/Save/Reenter	1	2	3
F3 - Glossary	1	2	3
F4 - Lesson Components	1	2	3
F5 - Main Menu	1	2	3
F10 - Scoreboard	1	2	3

COMMENTS/SUGGESTIONS:

DISTRIBUTION LIST

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